4-1-4-1-4-1 Model: Semester Structure with Time Slots for Project-Based Learning

Prof. Dr. Marco Winzker, Bonn-Rhine-Sieg University, 2016

Content

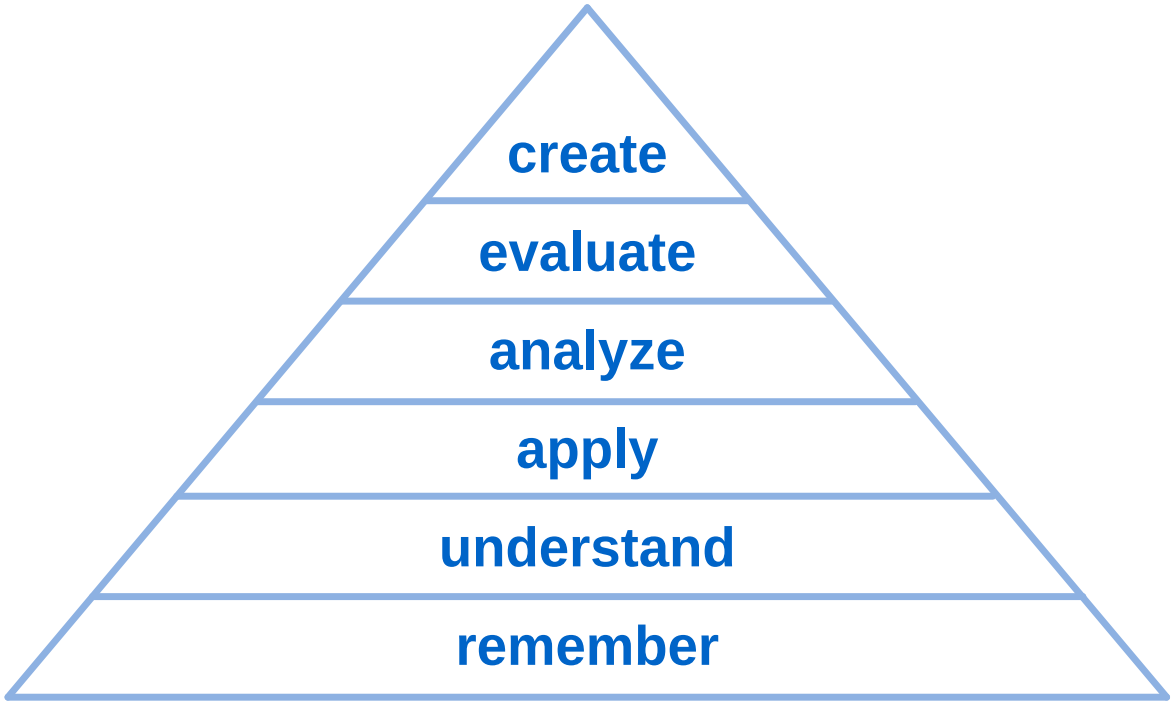
- Didactical Background
- New Semester Structure
- Examples for Student Projects
- Integration into Study Program
- Evaluation Results
- Assessment
- Change Process

“Shift from Teaching to Learning”

The Instruction Paradigm	The Learning Paradigm
- Provide/deliver instruction	- Produce learning
- Transfer knowledge from faculty to students	- Elicit students discovery and construction of knowledge
- Offer courses and programs	- Create learning environments
- Improve the quality of instruction	- Improve the quality of learning
- Knowledge exists "out there“	- Knowledge exists in each person's mind and is shaped by individual experience
·Knowledge comes in chunks and bits; delivered by instructors and gotten by students	- Knowledge is constructed, created
- Faculty are primarily lecturers	- Faculty are primarily designers of learning methods and environments

[Barr, Tagg, 1995]

Bloom‘s Revised Taxonomy



[Krathwohl, 2002]

Different level of proficiency

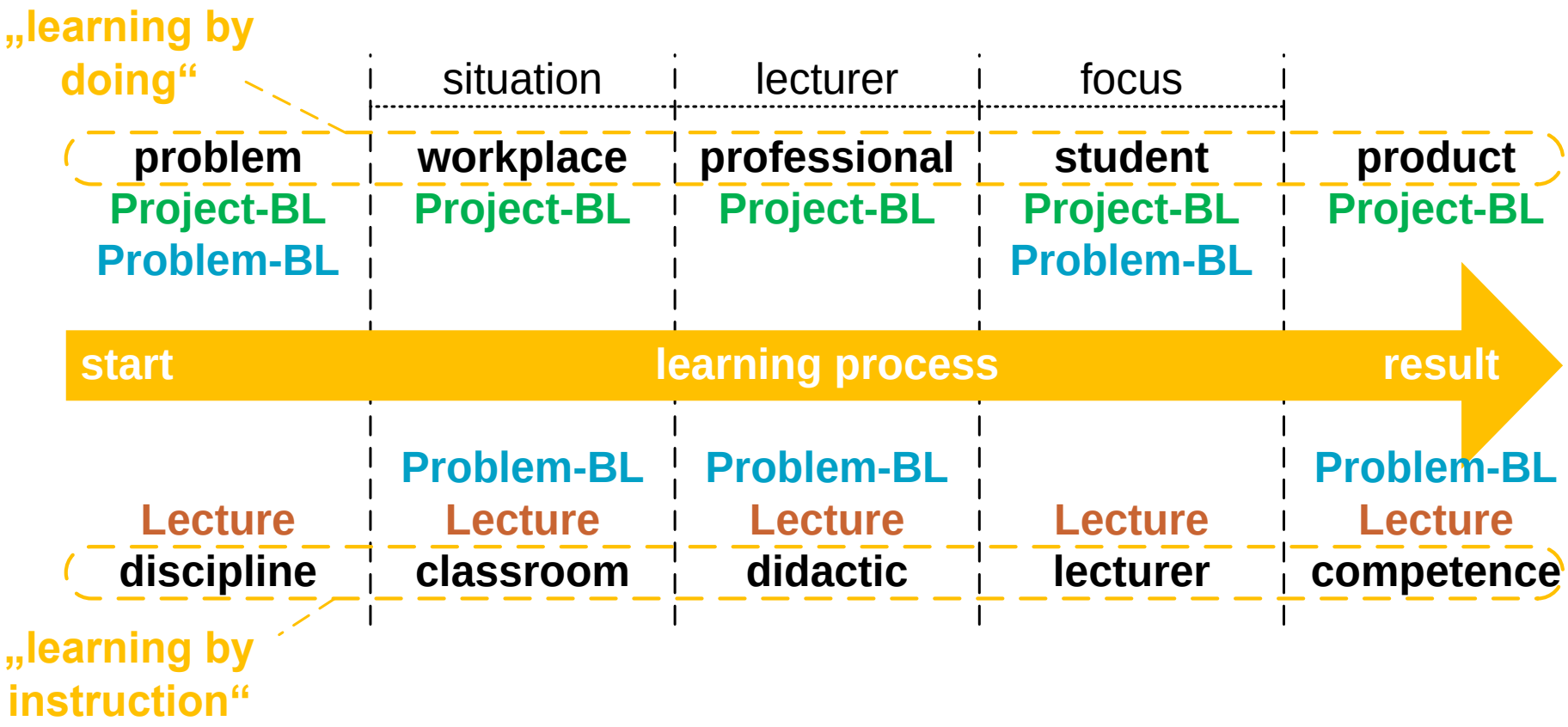
- Educators must define their learning objectives within the range
- Lower level give foundation for higher levels
- Higher levels for certain learning objective required for employability

PBL – One Abbreviation for Two Teaching Formats

- Project-based Learning (**PBL**)
  - Authentic problem from professional field
  - Independent project work by group of students
  - Project links knowledge from several topics

- Problem-based Learning (**PBL**)
  - Independent acquisition of knowledge in a group
  - Lecturers as “facilitators” guiding the students
    - Applied in medicine curriculum at McMaster University, Canada (1969) and Maastricht, The Netherlands (1974)
    - Applied in for different study programs, including engineering, at Aalborg University, Denmark (1974)

Project-Based Learning in the Educational Process



[De Graaff]

New Semester Structure “4-1-4-1-4-1-Structure”

- Initiative of Engineering Department
  - Department of Electrical Engineering, Mechanical Engineering and Technical Journalism (EMT)

- Improving the study program by **student-oriented teaching methods**
  - Dedicated time-slots for student-oriented teaching methods
  - Projects cannot be carried out in the 90-minute slots of a regular time table

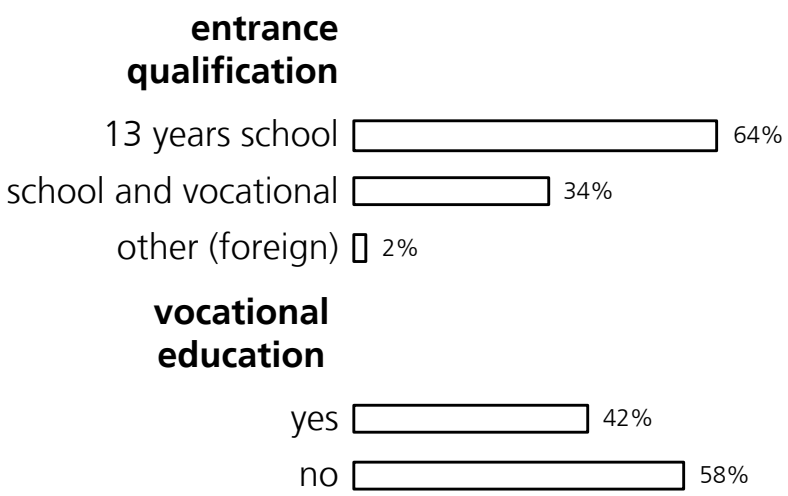
- Introduced in 2007
- Well established in Engineering Department

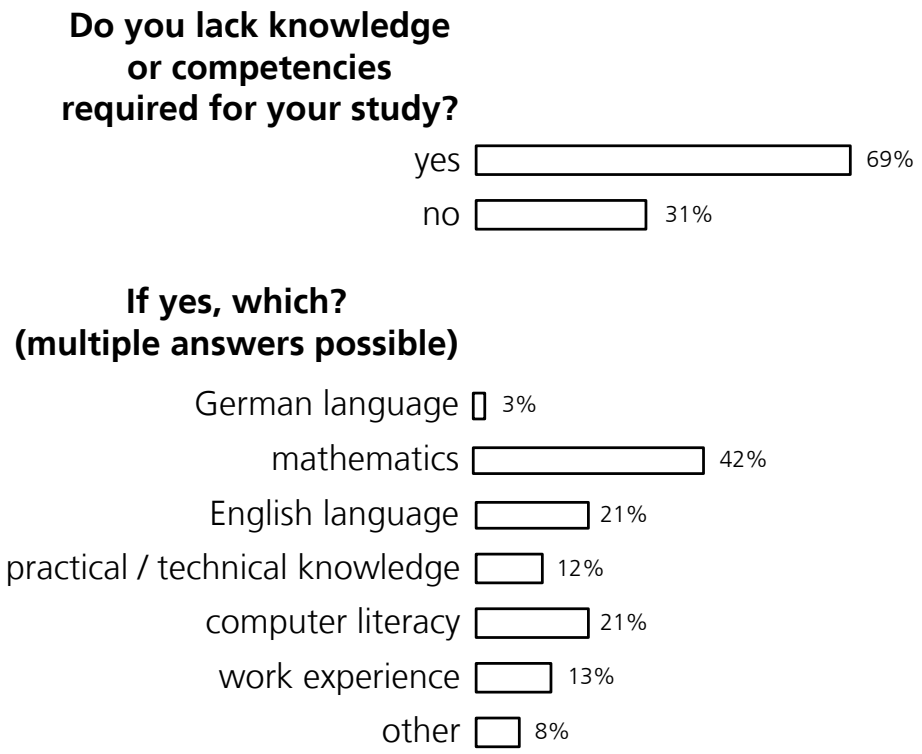
Academic Situation

- The Bonn-Rhine-Sieg University is a *Fachhochschule*, comparable to a polytechnic university
- Students enter a bachelor program with different educational backgrounds
  - 13/12 years of school
  - Combination of 10- to 12-year school education with vocational education
  - Foreign students*
- Evaluation of first year students by questionnaire
  - Questionnaire after two-thirds of the first semester
  - Major revision of curriculum in 2007, therefore all statistics for 2007
  - 149 responses in engineering department

- Note: “Foreign students” refers not to nationality but to an entry qualification obtained outside Germany

Questionnaire



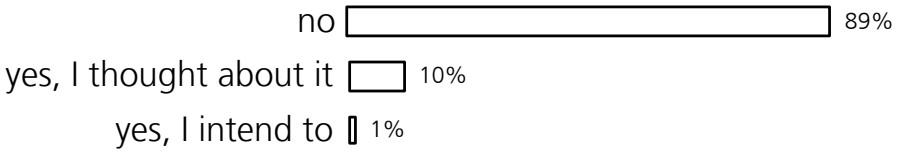


- Heterogeneity in the student body
- 69% of students believe, they lack competence
  - Mathematics
  - English language
  - Computer literacy

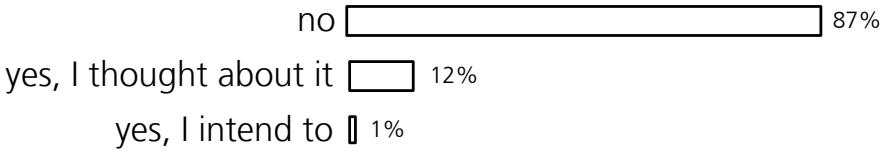
Questionnaire (II)

Do you intend to revise your decision for your study program and ...

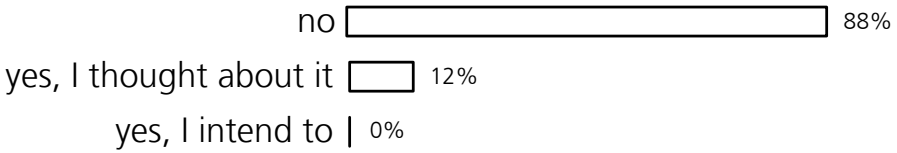
... change the subject?



... change university?



... give up your study?



- After two-thirds of the first semester 12% of students have thought about giving up their study or changing universities
- These students can still be reached and motivated to continue their study

Nationwide Studies

- Main reasons for not completing a study program are
  - Academic performance
  - Lack of academic integration
  - Lack of motivation
  - Financial problems

- Situation in Germany
  - Probably similar situation in other countries

[see: Heublein]

Approach

Improving the study program by **student-oriented teaching methods**

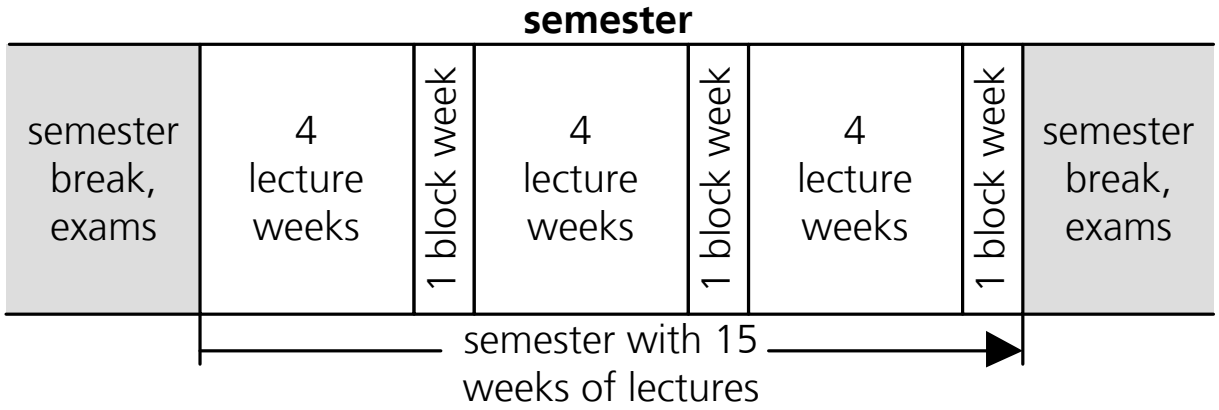
- Self-learning exercises
  - First year
  - Complete day for one module, e.g. mathematics
  - Opportunity to repeat and catch up with the subject
  - Problems with academic performance can be addressed
  - Better academic integration by working in groups
- Modules for project-based learning
  - Second and third year
  - Projects deal with engineering problems
  - Motivation of students
  - Further academic integration in the project groups
  - Students who have no vocational education can gather practical experience

New Semester Structure

- Dedicated time-slots for student-oriented teaching methods
- Projects cannot be carried out in the 90-minute slots of a regular time table

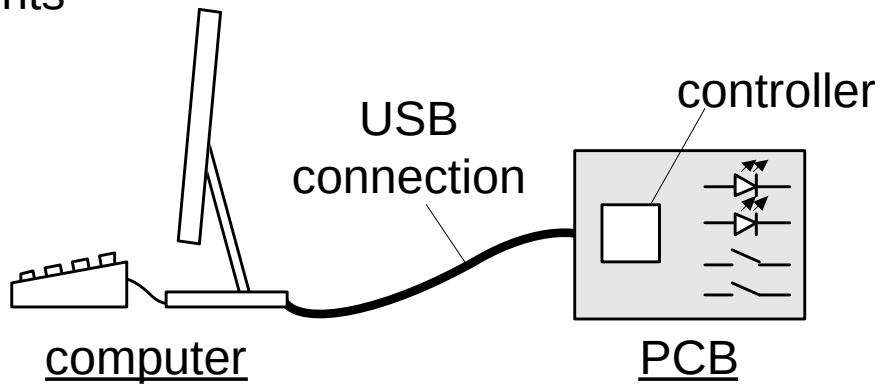
- Department-wide introduction of new semester structure
  - 15-week semester is split into sessions of 4 *lecture-weeks* and 1 *block-week*
  - Sessions are repeated three times in the semester in a **4-1-4-1-4-1**-structure

- *Lecture weeks* for "traditional" teaching formats, i.e., lectures, classroom exercises, and hands-on labs
- *Block weeks* for self-learning exercises and projects



Example of Engineering Project

- PCB with USB-interface
  - Design of a printed circuit board (PCB) with a USB interface
  - Computer reads the position of two switches and switches two LEDs on PCB
  - Project for students of electrical engineering in the third semester
  - 4 groups with 3 students



- Typical task for engineers
  - Selection of USB-controller
  - Circuit schematic and layout of a PCB
  - Programming, commissioning, debugging
  - Project management and coordination between different tasks

Project Activities – Students Perspective

Week 1

- Selection of a controller IC
- Development of a printed circuit board (PCB)

➔ 4 weeks interval for ordering the PCB and components

Week 2

- Assembly, commissioning debugging
- PC programming
- For some groups redesign of the PCB

➔ 4 weeks interval for ordering additional parts

Week 3

- Completion, documentation
- Final presentation

Project Activities – Lecturers Perspective

Monday

- Morning: Friendly welcome, start of project work
- Afternoon: Consulting, review of plan for the week

Tuesday, Wednesday

- 1 or 2 slots for consulting: specific technical questions

Thursday

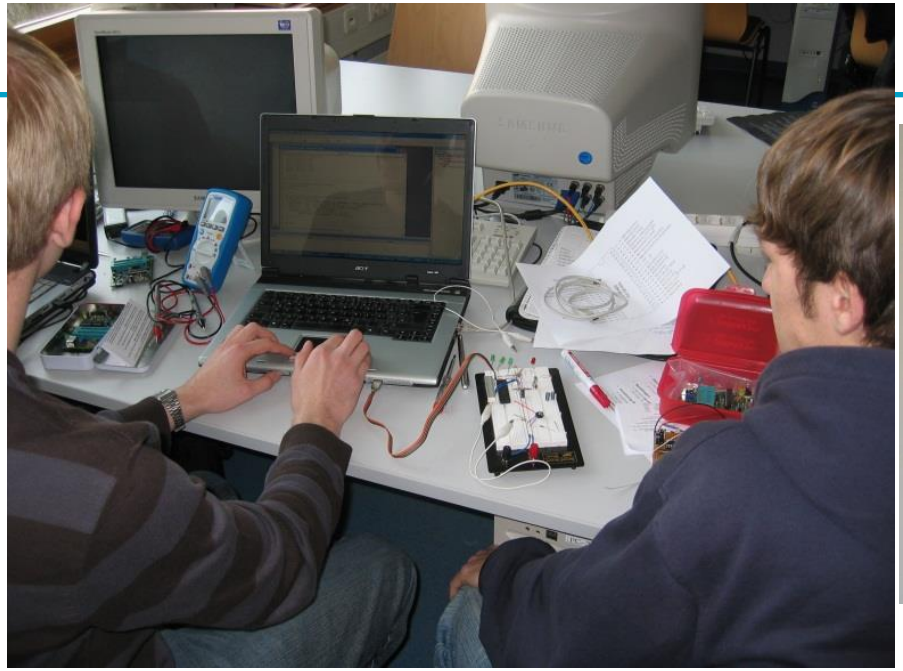
- Individual interview with all students:
  - What have you done this week?
  - Which problems did you face?
  - Have you observed something special?
    (Hidden question: “what have you learned?”)

➔ Combination of **assessment** and **didactic reflection**

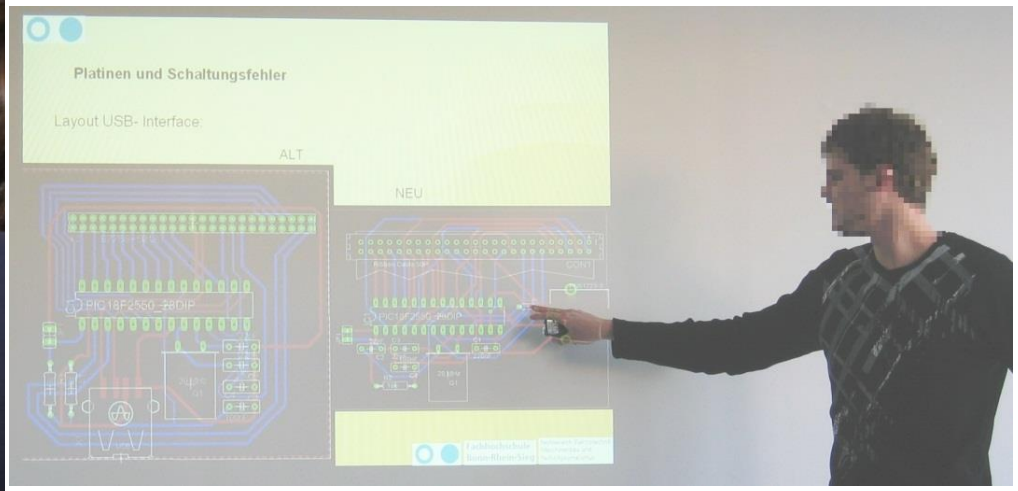
Friday

- Weekly or final presentation

Impressions

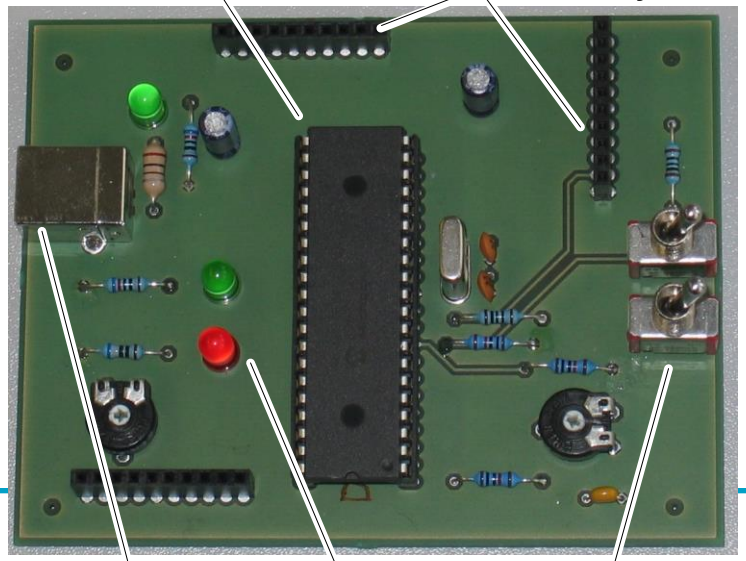


Project work



Presentation

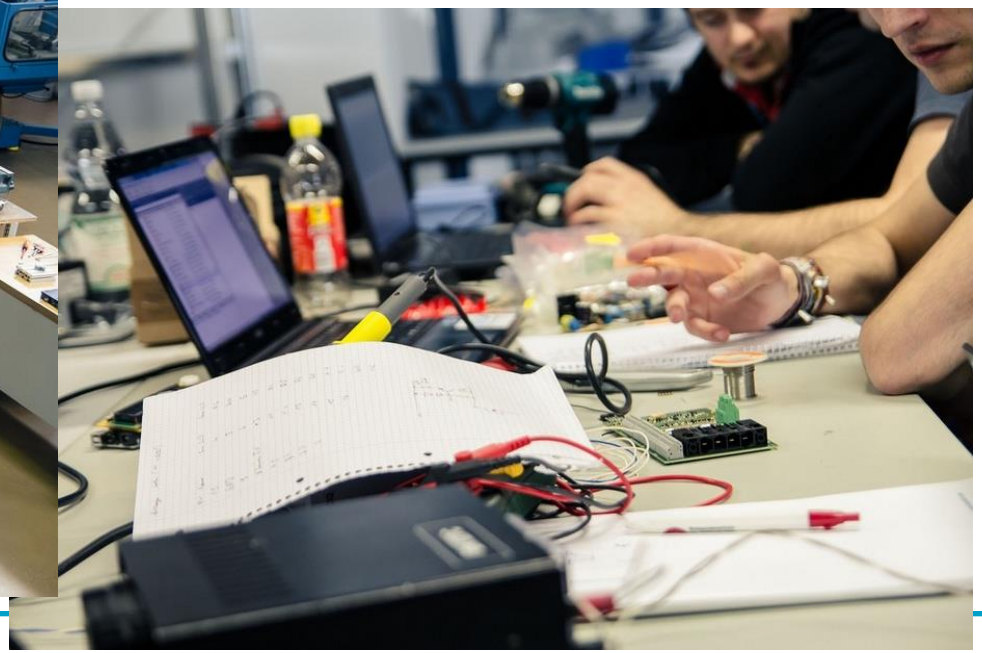
Product



Project Example: Formula Student

- International student competition
- Planning and building a race car
- Interdisciplinary including engineering, business administration, marketing
  - Students choose a task as their project

➔ Continuous project offered every semester



[Photos: BRS Motorsport]

Project Example: Journalism

Degree course “Technical Journalism”

- Journalists need to produce their articles, radio or TV reports with a strict deadline
- This time pressure is difficult to experience in a normal university time schedule
- The block week allows to set a realistic time frame
- Students have time to investigate outside the university
- Interviews can be scheduled with more flexibility

[Photo: H-BRS]

Project Example: Business Administration

Logistics with Lego-Cars

- Students assemble a car in an assembly line
- Planning of material flow, inventory, processing steps, ...
- Students can experience work of an assembly line

[Photos: H-BRS, M.C. Kemnitz]

Note:
Project is not organized in 4-1-4-1-4-1-structure

Integration into Study Program

- Projects are regular modules with 5 ECTS in the curriculum
  - Workload is calculated as 3 weeks with 40 hours

- In Germany work of lecturers is measured as “teaching hours” (SWS)
  - A teaching hour means 1 hour over 15 weeks of the semester
  - Lecturers at a Fachhochschule need to give 18 teaching hour
    - Activities like thesis supervision are also considered

- Lecturers get 2,4 SWS for a project with 15 students
- Lectures in regular weeks are considered with a factor of 0,8 (12 of 15 weeks)

➔ Lecturers have certain flexibility how to distribute their teaching time

Sustainability of Semester Structure

- Semester structure does not need additional funding
  - Available teaching capacity is sufficient for 3 projects in the degree course
- Lab rooms are used for project work
- Cost for material is within reasonable limits

➔ New semester structure was not financed by a special grant

Offering and Selection of Projects

- Lecturers can offer project from their field of work
  - Motivation to participate
  - Coordination required
- Students choose projects with priorities
  - Often 1st or 2nd choice can be assigned
  - However, some students get 3rd or 4th choice
  - Popularity of projects should be considered for offering of projects

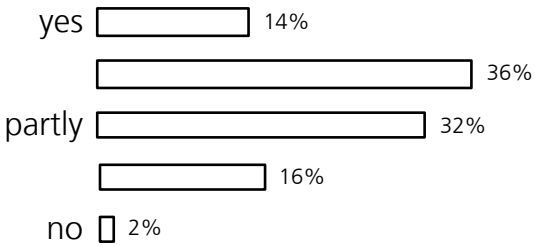
Example for choice of projects

- Winter term 2011/12
- 158 places for 133 students of electrical and mechanical engineering
  - 1st priority: 120 students
  - 2nd priority : 10 students
  - 3rd priority : 1 student
  - 4th priority : 2 students

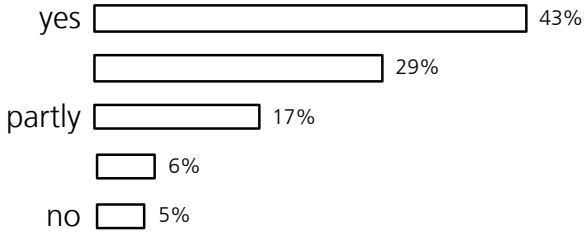
Evaluation of New Semester Structure

- Questionnaire at the end of study program (63 responses)

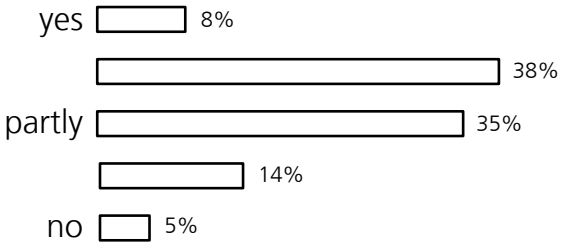
I have learned valuable technical knowledge



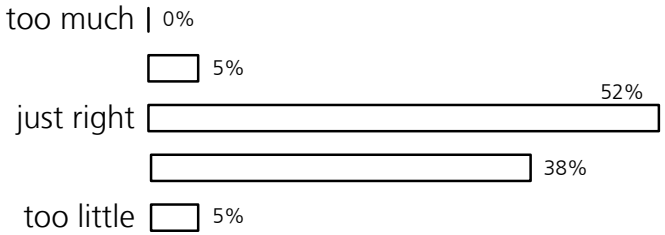
Cooperation in the groups was good



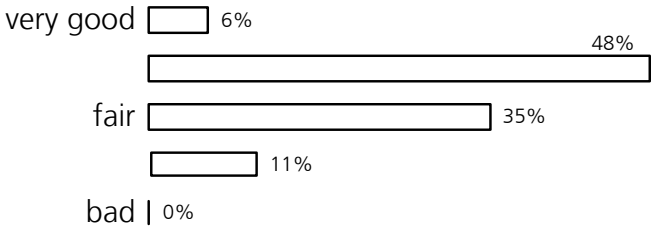
I improved my "soft-skills" (organization, project management, presentation techniques, ...)



Support by lecturers was



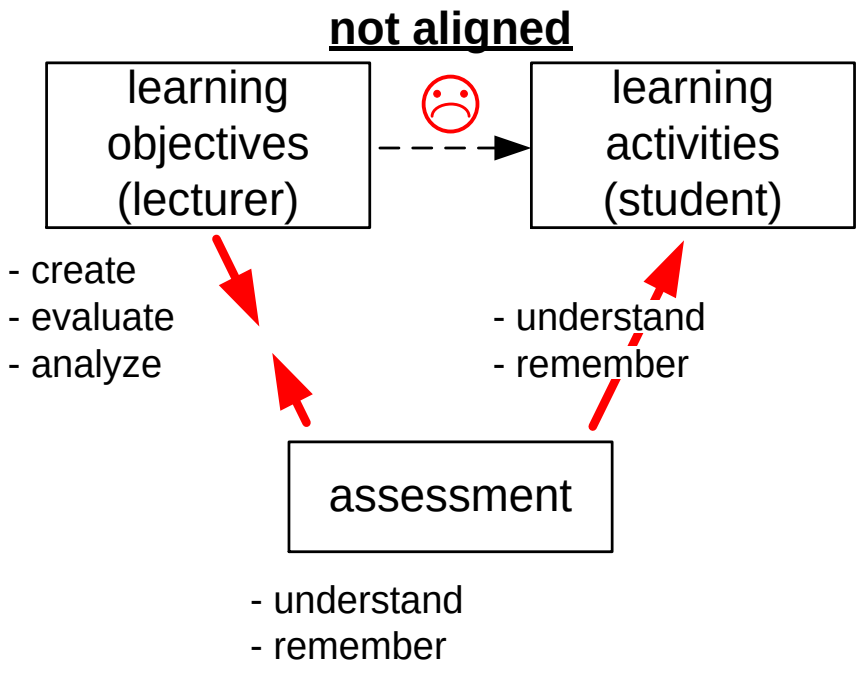
My overall rating of the projects is

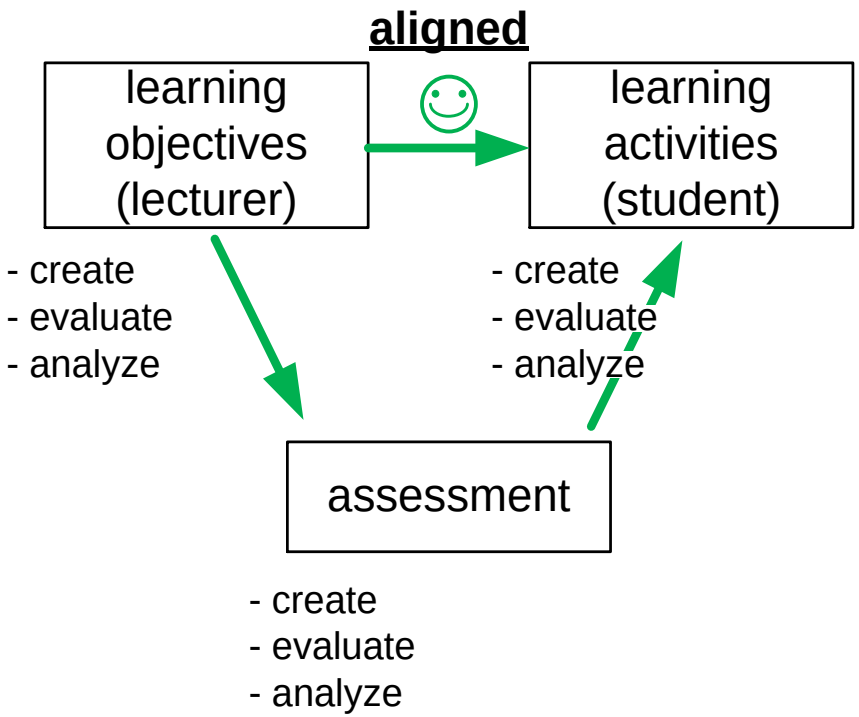


Assessment of Students

Constructive Alignment

- Learning of students is (often) driven by the assessment
  - ➔ A written examination is (often) not suited for project work





[see Biggs and Brabrand, Andersen]

Assessment of Projects in 4-1-4-1-4-1-Structure

- Students have limited time available for project work (3 weeks)
- Mistakes and delays are possible and should not be discouraged
  - Small decisions can lead to different project outcome
  - “Failure is instructive.” (John Dewey)
- Projects shall be opportunities to learn
  - By giving a grade, the “safest way” will often be chosen

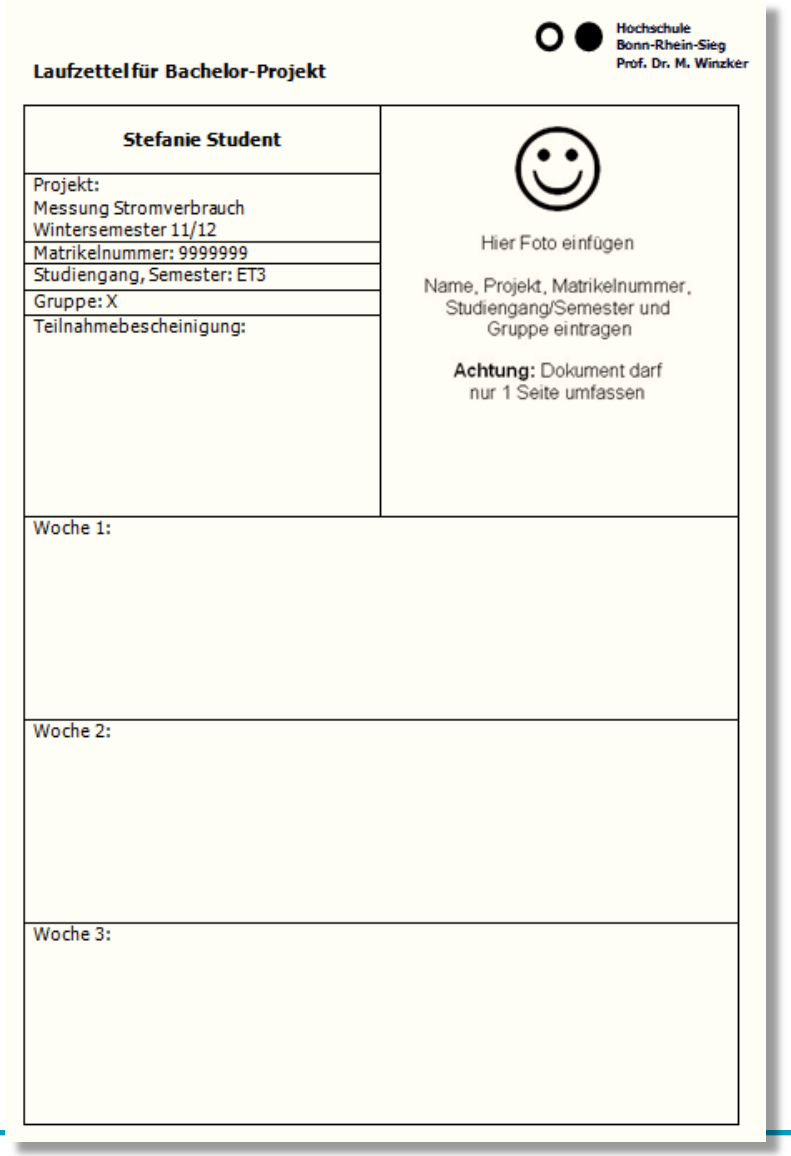
➔ Assessment as fail/pass without a grade

➔ Control of active participation during weekly interview

Assessment of Projects in 4-1-4-1-4-1-Structure (II)

Control of active participation

- "Profile Sheet" with photo for each student
- Regular visits to project room
- Short interviews in each project week
  - 5 ~ 10 minutes:
    What have you done this week?
    Which problems did you face?
- „Yellow Card" can be given in case of problems
  - Until now not issued
- Presentations at the end of each week
  - Each week different student



Hochschule Bonn-Rhein-Sieg
Prof. Dr. M. Winzker

Laufzettel für Bachelor-Projekt

Stefanie Student	Hier Foto einfügen Name, Projekt, Matrikelnummer, Studiengang/Semester und Gruppe eintragen **Achtung:** Dokument darf nur 1 Seite umfassen
Projekt: Messung Stromverbrauch Wintersemester 11/12	
Matrikelnummer: 9999999	
Studiengang, Semester: ET3	
Gruppe: X	
Teilnahmebescheinigung:	

Woche 1:
Woche 2:
Woche 3:

Alternative Assessment at TU Darmstadt

Assesment with Rubrics

- Seven categories:
  - Approach
  - Quality of result
  - Cooperation in the group
  - Documentation
  - ...
- Each categorie has 3 to 6 items graded with 0 to 4 points
  (more points mean better grading)
- Short explanation for each grade

➔ Effort for setting up the rubrics

➔ Structured approach for consistent grading, even whit several examiners

- Used in Master course with group of 4-7 students

[Glathe]

Example for Rubrics at TU Darmstadt

[Glathe]

Original Version in German

Punkte	Schriftliche Ausarbeitung: Struktur
0	Struktur der Arbeit nicht erkennbar bzw. nicht nachvollziehbar; Umfang viel zu lang; Detailergebnisse im Text; ohne Anhang
2	Struktur vorhanden und mit Einschränkungen erkennbar; Umfang der Arbeit vertretbar; Anhang vorhanden
4	sorgfältige, überzeugende Gliederung, die Verständnis fördert und Lesen erleichtert; Konzentration auf das Wesentliche im Textteil; gut strukturierter Anhang mit Verweisen

Loose Translation

Points	Written Examination: Structure
0	no structure, too much details, no annex, …
2	some structure, not too much detail, contains annex, …
4	clear convincing structure, right level of detail, annex with references, ...

Change Process

- Introducing the new semester structure required managing the change
  - All people are reluctant to change

Key factors for successful change

- Existing **structure for discussions** within faculty
  - Department council and retreat day
- Existing **ethos for excellent teaching**
- **External trigger** for change
  - Change from diploma to bachelor in “Bologna process”
- Definition of **goals**
- **Openness for discussion** and involvement of all stakeholders
  - Professors, staff, students
- **Sufficient time** (~ one year) for discussion of concepts

Summary

- New semester structure
  - Three “block weeks” for self-learning exercises and projects
    - 4-1-4-1-4-1 structure
  - 20% of the semester time for new teaching formats
  - Gradual shift is more realistic to achieve than a radical change

- Change process
  - Open discussion in faculty
  - Introduced in 2007; training workshops for faculty in 2008 and 2011
  - Experience and best practices discussed during strategic retreat days

- Status
  - New structure is sustainable, i.e. not depending on additional resources
  - Well established in Engineering Department

Literature

Reference for 4-1-4-1-4-1 Model

M. Winzker, "Semester Structure with Time Slots for Self-Learning and Project-Based Learning," IEEE EDUCON, 2012.

References

R. Barr, J. Tagg „From teaching to learning – A New Paradigm for Undergraduate Education,“ Change, 1995.

J. Biggs, „What the Student Does: Teaching for Enhanced Learning,“ Higher Education Research & Dev., 1999

C. Braband, J. Andersen, „Teaching Teaching & Understanding Understanding“, Kurzfilm, 2006. http://www.daimi.au.dk/~brabrand/short-film/

E. De Graaff, “Problem-versus Project-Based Learning in Engineering: Antagonist or Complementary Pedagogical Approaches,” VDI-Workshop, 2012.

W. Derboven, G. Winker, „Tausend Formeln und dahinter keine Welt […],“ Beiträge zur Hochschulforschung, 2010.

A. Glathe, „Die Verwendung von Rubrics zur Bewertung von Lernergebnissen,“ VDI-Workshop, 2012.

U. Heublein, et.al. „Ursachen des Studienabbruchs in Bachelor- und in herkömmlichen Studiengängen […],“ HIS, 2010.

J. Kotter, “Why transformation efforts fail,” Harvard Business Review, March-April 1995.

A. Kolmos, E. de Graaff, “Process of changing to PBL,” in: Management of Change, Sense Publishers, 2007.

D. Krathwohl, “A Revision of Bloom's Taxonomy: An Overview,” Theory Into Practice, Volume 41, Issue 4, 2002.

C. Luppertz, M. Winzker, et.al., Sharpening the Educational Toolset - Promoting Professional Development of University Lecturers," IEEE EDUCON 2016.

M. Winzker, et.al. “Using Evaluation Data to Initiate Change in the Study Entry Phase,” Zeitschrift für Hochschulentwicklung 9/2, 2014. http://zfhe.at/