Getting Started With Engineering: Our New Freshmen-Project On 3D Printing

Prof. Dr.-Ing. Martin Kraska
Program Manager Mechanical Engineering
Overview

• Introduction
• Mechanical Engineering at THB
• Module „Introduction to Engineering“
• First-Year project „DIY 3D printing“
• „Offene Werkstatt“ – a space for projects
• Summary
Introduction

Education:

- Mechanical Engineering in Moscow, Freiberg (Sa.) and Berlin
- Research and teaching assistant at the Institute of Mechanics at the TU Berlin

Professional experience:

- Structural analysis at CargoLifter
- Metal forming simulation at INPRO Berlin
- Non-destructive testing and process monitoring
Introduction

Teaching at THB:
• Engineering Mechanics (1st year)
• Materials science (2nd year and master)
• Finite element analysis (3rd year and master)
• Product development (2nd year)

Research at THB:
• Mechanics of materials and structures
• Free math software
  • Documentation, tutorials, examples
  • Development of extensions
Introduction

Further activities:

• Program manager for Mechanical Engineering (B)
• Major update of the program just finalized
• Setup of a student’s working space (FabLab)
• First-year project „Build a 3D-Printer“
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Mechanical Engineering at THB

Basic facts

• Until 2007: 8-term Diploma program
• Since 2008: 7-term Bachelor program
• Since 2014: 3-term Master program
• Enrollment between 160 and 50 per year
• Drop-out rate between 40 and 50%
• Increasingly heterogeneous entrance level
Mechanical Engineering at THB

Performance of 2009 Freshmen

Switchers
Drop-out
Undergrad
Graduates
Mechanical Engineering at THB

Maximum number of students with at least one successful exam by year of enrollment
Mechanical Engineering at THB

Reasons for drop-out in bachelor programs

Not fit enough 31%
Lack of motivation 18%
Lack of hands-on activities 15%

Objectives for change

• Reduce drop-out rate
• Attract more students
• Update of contents
• Simplify administration
• Increase international/intercultural mobility
• Better fitness for master program
• Synergy with other programs
New Mechanical Engineering

Major Changes

• New base structure
• Specializations
  • Product Development
  • Drive Technology
  • Process Engineering
• Modul „General Competences“
• First-Year project

Voluntary Internship
Basics
Internship/study abroad
Specialization
Bachelor project/thesis
Master
Master project/thesis
New Mechanical Engineering

Module „General Competences“

- Inspired by FH Aachen
- 5 ECTS as reward for engagement and personal development in
  - Teaching/mentoring
  - Academic self-administration
  - Preparing a term abroad
- Formal allocation in the 4th term
- In practice any distribution over the terms is allowed
New Mechanical Engineering

Internship/Study abroad

- Term 4 (February-September)
- Choice between internship oder study abroad

Internship

- 20 weeks fulltime
- Report and Seminar in term 5

Study abroad

- 20 ECTS in specialization, 5 general ECTS
- Erasmus-compatible study agreement
- En bloc-acknowledgement requires report and participation in advertising study abroad
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Introduction To Engineering

State of the art

• 20% of the ASIIN-approved ME programs have an Introduction module (ASIIN: Bologna enforcement agency)
• 1-6 ECTS (average 3.4)
• Weekly or en-bloc (4-10 days)
• Teams of 3-20 students (average 8)
• Sometimes integrated with lectures on mech. design
• Sometimes graded, sometimes not
• Mostly, includes final presentations

[Kühnel 2018]
Introduction To Engineering

Other 1st year projects at FBT

- Started 3 years ago for non-ME programs
- Groups of 10 students, each mentored by a staff member (professor or lecturer)
- Varying tasks which included some illumination electronics (LED based lamps)
- Task includes creative design
- Hands-on limited to soldering (no student’s workshop available)
- Initially 5 ECTS, now 2ECTS
Observations in the Mech. Eng. program

• Foreign students tend to separate – poor command of german even in third year
• Heterogeneous practical experience (from not even knowing a gear wheel to full vocational training)
• Heterogeneous motivation (no idea of engineering to well determined selection of subject and school)
• Program biased towards mechanical design with metal materials. No electronics, no mechatronics, no plastics, no programming
Introduction To Engineering

Setup of the module for Mech. Engineering

- 1st term of Mechanical Engineering
- 2 ECTS
- Component 1: Series of lectures (1hr per week)
- Component 2: Hands-on project (2hrs per week)
  - Location: Student’s lab (Offene Werkstatt)
  - Idea: Build DIY 3D printers
**Introduction To Engineering**

**Objectives**

- Provide an idea about engineering and engineers
- Tie the students to the school
- Team-building
- First contact with technical systems for students without vocational training
- → Reduce drop-out
Introduction To Engineering

Series of lectures (examples)

• Introduction to 3D Printing
• Bio of famous engineers
• Bio of THB or other graduate engineers
• Areas of Engineering
• Areas of professional activity
• Software tools for engineers
• Engineering ethics
• Employment vs freelancing
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First-Year project „DIY 3D printing“

The task

• Build and operate an Anet A8 3D printer
• Pimp the printers by self-printed parts
• Prepared by a master thesis (Madlen Kühnel)
First-Year project „DIY 3D printing“

Team composition

- Teams of 4-5 students (reduced risk of inactivity)
- Mix experienced and unexperienced students
- Mix native and non-native german speakers (no team of only Chinese)

Further life cycle

- Use printers in various courses: mechanics, materials, design, manufacturing, control
- Display results at Open Door day in spring
First-Year project „DIY 3D printing“

Facts

- Costs: 130€ per set/team (kick-off funding by ZHQ)
- Time required for building: 8h (2x4h, tested with 1st year students)
- Workshop capacity: 2 supervisors, 3 teams (12-15 students)
- 3 compulsory supervised sessions per team
- 12 sessions per term serve 12 teams (48-60 students)
- Augmented by free workshop sessions
- Weekly costs: 2x4hr teaching staff per week, 2x4hr students
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FabLab – „Offene Werkstatt“

- Under construction since end of 2016
- Launched by a team of volunteers:

Prof. Dr.-Ing. Martin Kraska
Werkstoff- und Strukturmechanik

Dipl.-Des. M.Eng. Lisa Jakobi
Qualität der Lehre FBT

Dipl.-Ing. Steffen Rotsch
Konstruktionslehre
FabLab – „Offene Werkstatt“

IWZ I, R 010

storage

metal/wood

soldering, electronics

assembly

plastics

Rapid Prototyping

Kommunikation

storage
FabLab – „Offene Werkstatt“

Objectives

- Holistic Rapid prototyping
- Space for learning by doing
- Transparent access to equipment and skills
- Get hands on ideas

Next steps

- Transition from self-exploitation to sustainable funding
- Regular use for curricular students’ projects
- Opening for schools, students and the public
- Gain regional visibility/reputation
FabLab – „Offene Werkstatt“

https://offene-werkstatt.th-brandenburg.de/
FabLab – „Offene Werkstatt“

Media coverage

- http://www.maz-online.de/Lokales/Brandenburg-Havel/Keksausstecher-und-Profi-Prototypen
- https://www.youtube.com/watch?v=RI_cqS4mNCk
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Wish us good luck!
Thank you for your attention!
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(Poly)Technical Subjects at School in GDR

**Werken** (handicrafts)
- Class 1-6, 1-2hrs per week

**ESP** (Introduction to socialist production) and **PA** (productive work)
- Class 7-10, 4 hrs per week

**WPA** (Scientific-practical work)
- Class 11-12, 2 hrs per week

1 term Mandatory **pre-university internship** for most programs (with some exceptions)

Sometimes motivated by sheer to lack of workforce (e.g. night shifts in the hospital laundry)