



# **Work-Integrated Engineering Education for a better World of Tomorrow**

**Prof. Dr. Jürgen Kretschmann**



**Our aim: Engineering for a better world**

- Disconnect between the students' focus on degree studies and their personal career preparation (prestigious university level brands is more important than the quality of the individual program)
- Disconnect between students' study at university and what employers value in practice (“two worlds”)
- High youth unemployment rate in some countries, others have a lack of talents
- All-time highs in graduates from universities and colleges (But quantity is not quality!)

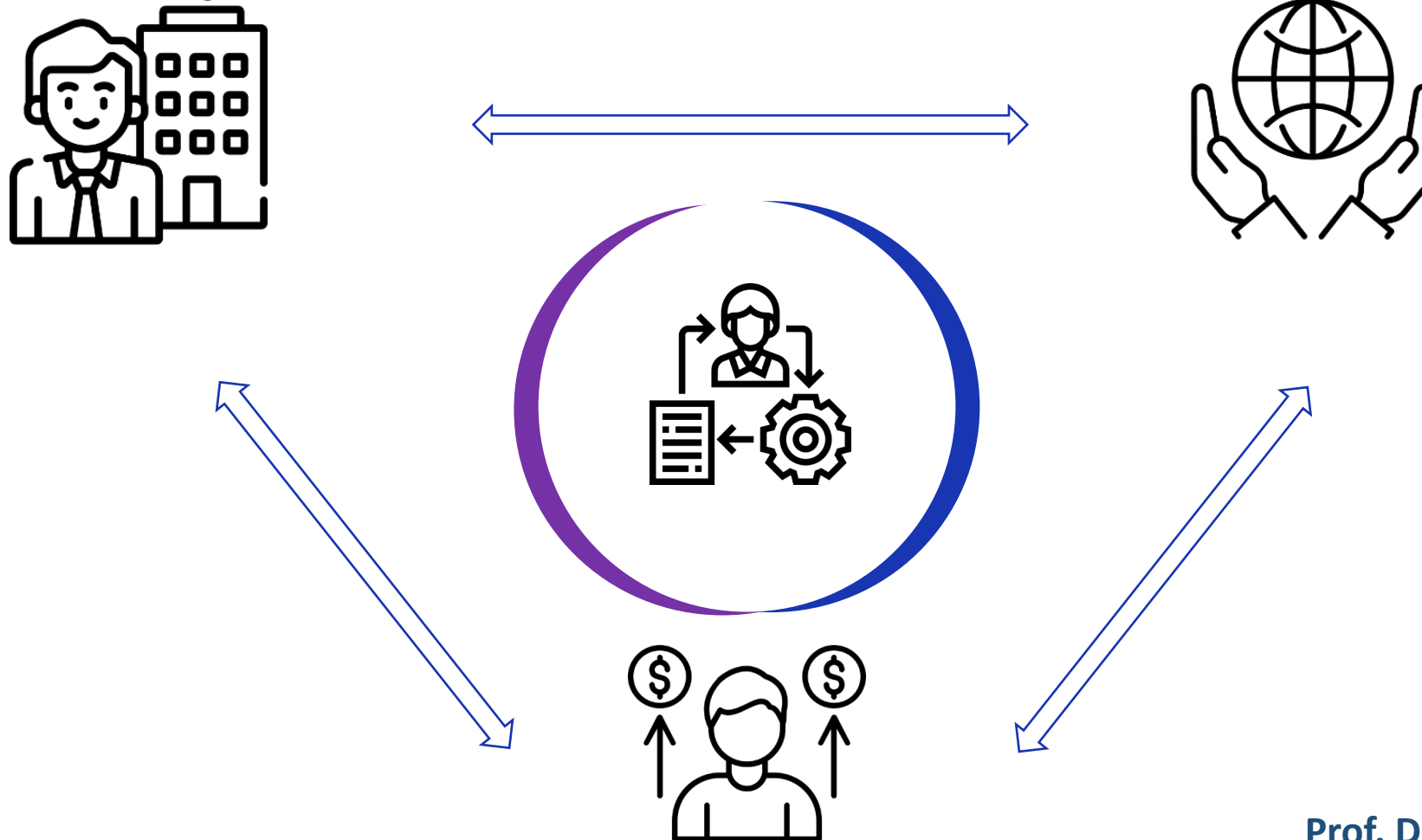
- **Mostly theoretical knowledge (know why)**
- **Subject–area knowledge (inside a box)**
- **Learn what the teachers say (hierarchical, teacher-centered)**
- **Give “right” answers**

# Two Worlds: Employers' values

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- **Practical learning with impact (know how)**
- **Transversal skills (problem-solving, communication, teamwork, creativity, emotional intelligence...), real-world knowledge (out of the box)**
- **Develop self-responsibility and –management, innovative thinking, personal branding (unique value)**
- **“Can-doers”, soft qualities like willingness to learn (learning agility)**

***Guiding Principle: To create meaningful educational programs you need to know your stakeholders and care about their interests.***



- **A study program based on a strategy at the university that restructures the whole education program**
- **by integrating all kinds of active and empowerment orientated learning, interdisciplinary project work and work-integration (internships)**
- **to educate both technical knowledge and competencies, and professional or employability competencies.**

# Students' interests

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- **a prestigious degree, highly competitive in the labor market**
- **interesting and future-orientated study programs**
- **an ideal preparation for the professional life**
- **job security in times of unemployment**
- **career perspectives**
- **a suitable job environment in the future**



# Employers' interests

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- **excellent educated talents to secure the personal development**
- **productive and innovative graduates useful for the company from Day 1**
- **in best-case no gap between the required skills and the available skills of the graduates**
- **highly motivated and loyal employees to secure the future competitiveness of the company**

- ***Secure higher living standard and social security in the future by keeping young talents in the region (no emigration)***
- ***Reaching the SDGs through educating highly qualified specialist and experts***
- ***Integration of young people in the labour market; deficits in employability might lead to unemployment***
- ***Positive educational development of the region and the country by participation***

# Why integrating theory and practice? Because Engineering disciplines are applied sciences!

- All engineering disciplines have an impact on the society and its members: companies, organizations, administrations, individuals.
- Because engineering leads to results that can change parts of the world forever (progress).
- Students and young researchers should be able to apply their knowledge in a responsible way to find the best solutions.
- Therefore universities should empower them. To create a better, more sustainable world!



- ***Integrating engineering and practice (Theoria cum praxi (G. Leibniz 1666) in education***
- ***Learning professional skills during studying. Socialisation in engineering should not begin after graduation, but in the first semester!***
- ***Make engineers understand the nature of their profession in terms of ethics, norms, conventions, cultural practices and professional language***
- ***Teaching practical thinking to prepare future engineers for their future contributions to societal, industrial and ecological development (SDGs).***

## The work-integrated study program: Starting Phase

- The first semester is an “onboarding” semester. The focus here is to integrate the students into the university life, its processes and the aims of studying.
- The first steps involve empowering the students to use their knowledge and creativity, the improvement of their self-organization and team-work, plus the improvement of their language skills as the focus of study programs.
- The students learn what it means to study engineering and are informed about their career perspectives by the professors and guest lecturers from companies. They are introduced into scientific writing and project work.
- In the second and third semester the students learn the necessary fundamental knowledge of their study programs: As an example in Digital Technologies: mathematics, foundations of computer science, algorithms and data structures, object-oriented programming, data bases, data security, foundation of business administration and other classes.
- *Besides they are prepared for their internships though company visits, CV and motivation letter writing, interview preparation...*

- After the third semester, the students do their first internship for two or three months in companies to apply their knowledge. Of course, at the beginning, the employer has to invest time and efforts in the talents. But, the more they learn in practice the better they know how to apply their knowledge to support the company.
- During the following semesters, students expand their theoretical knowledge on campus in classrooms, in exercises and in special teaching support facilities like laboratories or (virtual) learning factories. In DT courses deal with topics like business process modeling and IT systems, data mining, machine learning, AI, speech and image recognition, web technologies etc. Elective modules are change management, diagnosis and predictive maintenance, industrial control technologies, marketing and technical sales, sensors and actuators among others.
- To increase the employability of the students based on the demand of industry lecturers with special expertise from practice are employed. They enrich the theoretical knowledge of the students with their applied knowledge, especially in elective modules.

海南比勒 费尔德应用科学大学 2024-2025学年第三学期校 历  
Academic Calendar BiUH 2024-2025 3rd Semester

	八月 August		九月 September					十月 October					十一月 November					十二月 December					一月 January				二月 February						
星期一 Monday	☆19	26		2	9	16	23	30		7	14	21	28		4	11	18	25		2	9	16	23	30		6	13	20	27		3	10	17
星期二 Tuesday	20	27		3	10	17	24		1	8	15	22	29		5	12	19	26		3	10	17	24	31		7	14	21	28		4	11	18
星期三 Wednesday	21	28		4	11	18	25		2	9	16	23	30		6	13	20	27		4	11	18	25		1	8	15	22	29		5	12	19
星期四 Thursday	22	29		5	12	19	26		3	10	17	24	31		7	14	21	28		5	12	19	26		2	9	16	23	30		6	13	20
星期五 Friday	23	30		6	13	20	27		4	11	18	25		1	8	15	22	29		6	13	20	27		3	10	17	24	31		7	14	21
星期六 Saturday	24	31		7	14	21	28		5	12	19	26		2	9	16	23	30		7	14	21	28		4	11	18	25		1	8	15	22
星期日 Sunday	25		1	8	15	22	29		6	13	20	27		3	10	17	24		1	8	15	22	29		5	12	19	26		2	9	16	23
教学周数 Academic Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8										
学期 Semester	冬季学期 Winter Semester															实践 Practice								无课期 Lecture Free									

海南比勒 费尔德应用科学大学 2024-2025学年第四学期校 历  
Academic Calendar BiUH 2024-2025 4th Semester

	二月 February	三月 March						四月 April					五月 May				六月 June					七月 July				八月 August						
星期一 Monday	☆24		3	10	17	24	31		7	14	21	28		5	12	19	26		2	9	16	23	30		7	14	21	28		3	10	17
星期二 Tuesday	25		4	11	18	25		1	8	15	22	29		6	13	20	27		3	10	17	24		1	8	15	22	29		4	11	18
星期三 Wednesday	26		5	12	19	26		2	9	16	23	30		7	14	21	28		4	11	18	25		2	9	16	23	30		5	12	
星期四 Thursday	27		6	13	20	27		3	10	17	24		1	8	15	22	29		5	12	19	26		3	10	17	24	31		6	13	
星期五 Friday	28		7	14	21	28		4	11	18	25		2	9	16	23	30		6	13	20	27		4	11	18	25		1	7	14	
星期六 Saturday		1	8	15	22	29		5	12	19	26		3	10	17	24	31		7	14	21	28		5	12	19	26		2	8	15	
星期日 Sunday		2	9	16	23	30		6	13	20	27		4	11	18	25		1	8	15	22	29		6	13	20	27		3	9	16	
教学周数 Academic Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8									
学期 Semester	春季学期 Spring Semester															实践 Practice								无课期 Lecture Free								



# About Learning and Motivation

Edgar Dale's „Cone of Experiences“ shows people remember much more by field trips, demonstrations and own experiences than by verbal or visual symbols (reading or listening) (Dale 1969).

So, the aim of work-integrated studying is firstly to learn with all senses, to develop skills and attitudes, and to understand processes and relations.

Learning is often not done with the head alone, but with the hands (touching), the heart (emotions), the skin (heat, coldness) and sometimes with the whole body (very strenuous work), and of course mostly in teams.

Students get to know why their study program is very relevant in practice, why she or he is important for industry and beyond. Practical work can allow future engineers to gain and apply valuable knowledge through structured, supervised, hand-on experiences (Chakrabarti et al. 2021, p. 131.)

The students learn what they will be able to do in the future. This can be an immense driver for their motivation to finish their program as successfully as possible.

# Educational Approach

- Lecturing



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- Allowing the students to learn by their own experience



- Providing supervision (if needed).

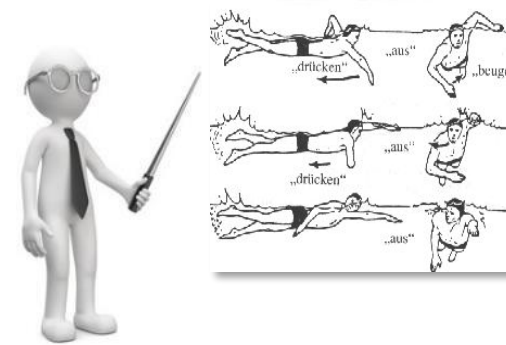


- “Empowerment Teaching”
- Teaching students in an activating manner

or in other words...

# Educational Approach

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  - Tell the students how to swim.
- Throw the students into the water
  - and watch them swimming.
- Provide supervision
  - (if needed).



- Bachelor theses will be written in companies.
- It is a three months thesis written so apply knowledge to solve a problem in practice, to improve a challenging situation.
- Students should be able to apply their knowledge with a positive innovative and productive impact for the employer.
- They should be able to use their transversal skills (problem-solving, communication, teamwork, creativity, emotional intelligence...) self-responsible.
- The thesis is supervised by both a responsible university professor and a responsible expert from practice.

- To better cultivate talents for enterprises and realize the work-integrated studying model, a tripartite internship agreement between the university, the enterprise and the students should be formulated.
- The agreement is necessary to define the rights and obligations of each party.
- It should be signed by legal or authorized representatives of the university and the companies and the individual student.
- The term of the agreement should be medium or long term to secure a reliable cooperation in the interest of all participants.

- to organize interviews with students for internships,
- work out specific internship plans and timetables with the companies.
- During the internship appoint a person responsible for supervising and supporting the students, give them advice and guidance, and inspect the internship situation.
- Establish management methods and feedback mechanisms for students in companies, motivate them and secure the transparency of information.

The company's obligations are

- to appoint a professional tutor to guide the practice process. He is responsible for formulating the internship plan and guiding the content of the internship, as well as carrying out an evaluation and assessment of the student's internship.
- The tutor must have a bachelor's degree or higher. He has to guarantee students will be provided with specific hands-on practice related to their study program and may participate in company projects.
- The enterprise should provide an appropriate subsistence allowance for the student during the internship.

# The Tripartite Agreement: Obligations of the students

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- Students are strictly required to follow the rules governing the internship phase and must not violate the Student Code of Conduct or the company's rules.
- During the internship phase, students might attend classes or have to self-study.
- They have to submit an internship report on their activities.
- they have to keep trade secrets and confidential matters related to intellectual property rights of the company.



- Taylor-made cooperations, but standardized
- Flexible content based on the individual situation of the company
- Agile: development of the cooperations based on experiences and lessons learned

- In applied sciences like engineering, theoretical and practical education can be realized in harmony.
- Work-integrated study programs can be a role model for innovative engineering education. The empowerment of the “next generation of engineers” should be the paramount aim.
- Universities can teach students with an integrated strategy “theory with practice” from the beginning. This is more efficient than a sequential procedure learning theory first, and years later practice (when most of the theory has been forgotten).
- Work-integrated engineering education can secure a sustainable development and a better future for everybody, but the universities, the companies and the society should work together hand in hand!



**BiUH**

**Thank you very much  
for your kind  
attention!**

**Prof. Dr.  
Jürgen Kretschmann**