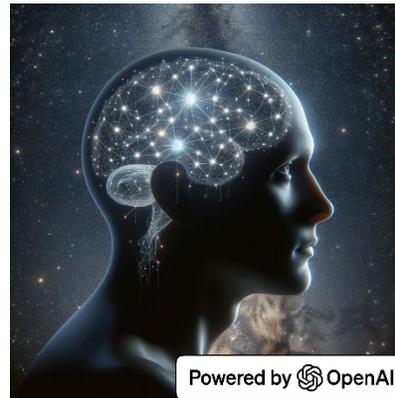
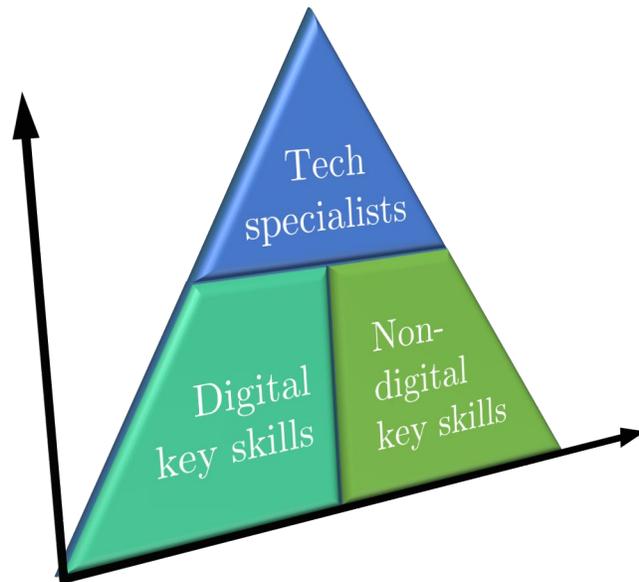


On methods to motivate students to self-organized learning and to enable them to acquire “future skills“

Thorsten Bartel



IFTtoMM YFG-MMS · Online · 19. - 21.11.2024

(Personal) Motivation

Since 2019, in-depth training in modern didactics
(IngenieurDidaktik TU Dortmund, Prof. Dr. T. Haertel, Dr.-Ing. Silke Frye)

Motivated by

- Dissatisfaction with the skills and competencies to be acquired in our lectures
- Dissatisfaction with the skills to be acquired throughout the course of study
- Persistent unsatisfactory performance by students in exams
- In some cases, a strong and difficult-to-resolve discrepancy between the competencies acquired during the course of study and those necessary for scientific work
- Outstanding engineering graduates do not feel at all well-trained as engineers

Overarching activities



- Initiator and coordinator of the technical committee “Modern teaching and didactics in mathematics and mechanics” of the German Association for Applied Mathematics and Mechanics (GAMM)
- Application for and coordination of the project “DTM – Digitale Technische Mechanik” as part of the initiative OERContent.nrw 2022



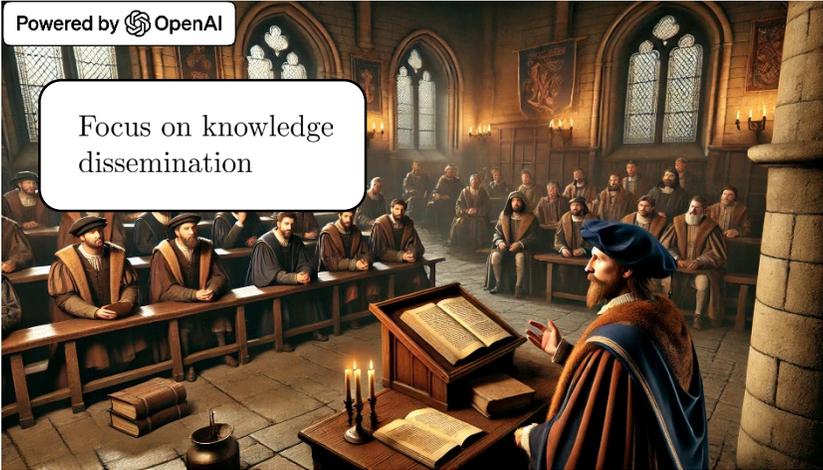
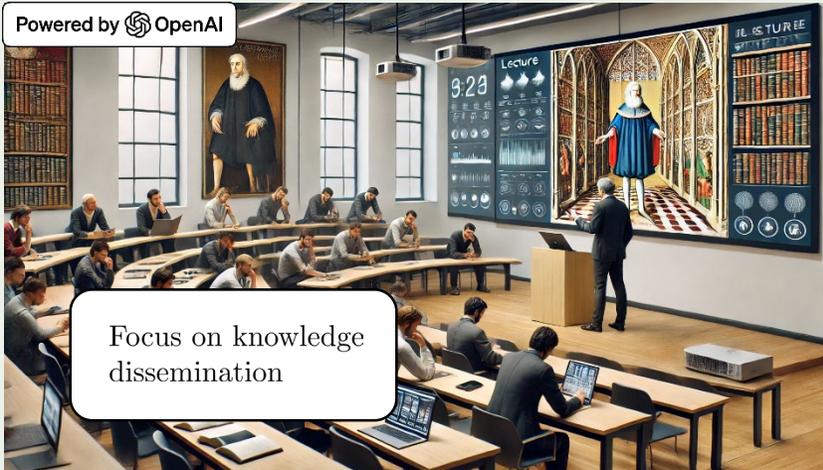
Main goal: Development of a new and holistic concept for improving basic education in the field of “mechanics” together with eight universities in North Rhine-Westphalia.

Gefördert durch:

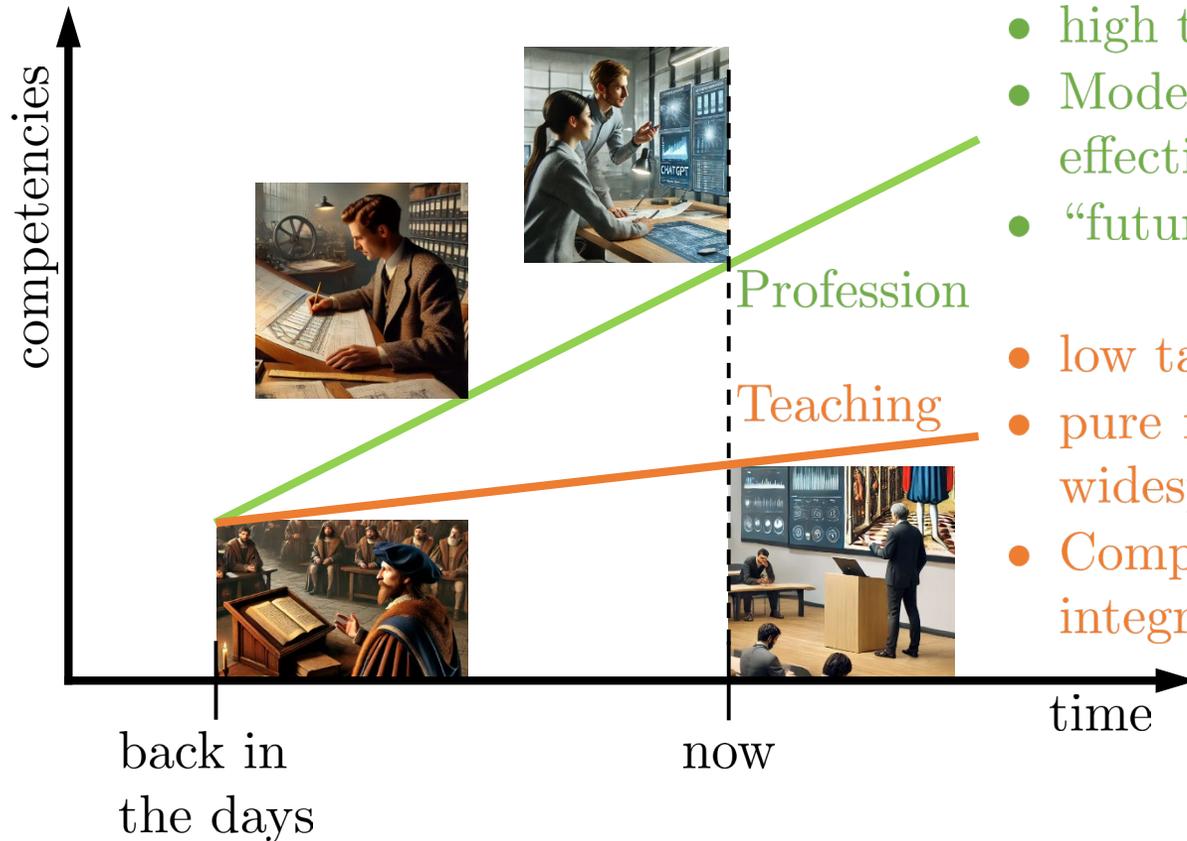
Ministerium für
Kultur und Wissenschaft
des Landes Nordrhein-Westfalen



Development disparities

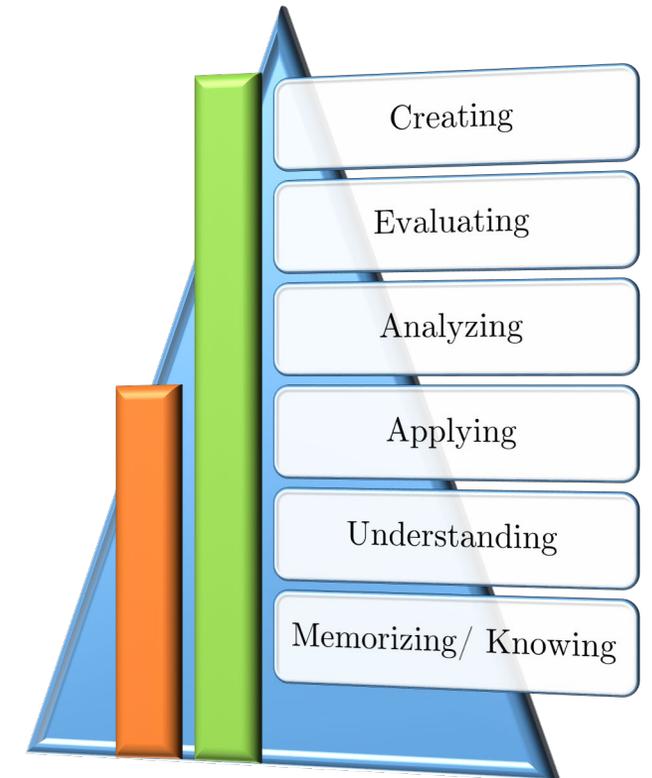
	Back in the days	Now
Profession	 <ul style="list-style-type: none">• Collecting hard-to-find knowledge• Manual implementations• Approximations <p>Powered by  OpenAI</p>	 <ul style="list-style-type: none">• Knowledge always available• Computer use• Detailed analyses/optimization <p>Powered by  OpenAI</p>
Teaching	 <p>Powered by  OpenAI</p> <p>Focus on knowledge dissemination</p>	 <p>Powered by  OpenAI</p> <p>Focus on knowledge dissemination</p>

Development disparities



- high taxonomy levels
- Modern technology as an effective and efficient aid
- “future skills”
- low taxonomy levels
- pure rote learning is still widespread
- Computer skills barely integrated

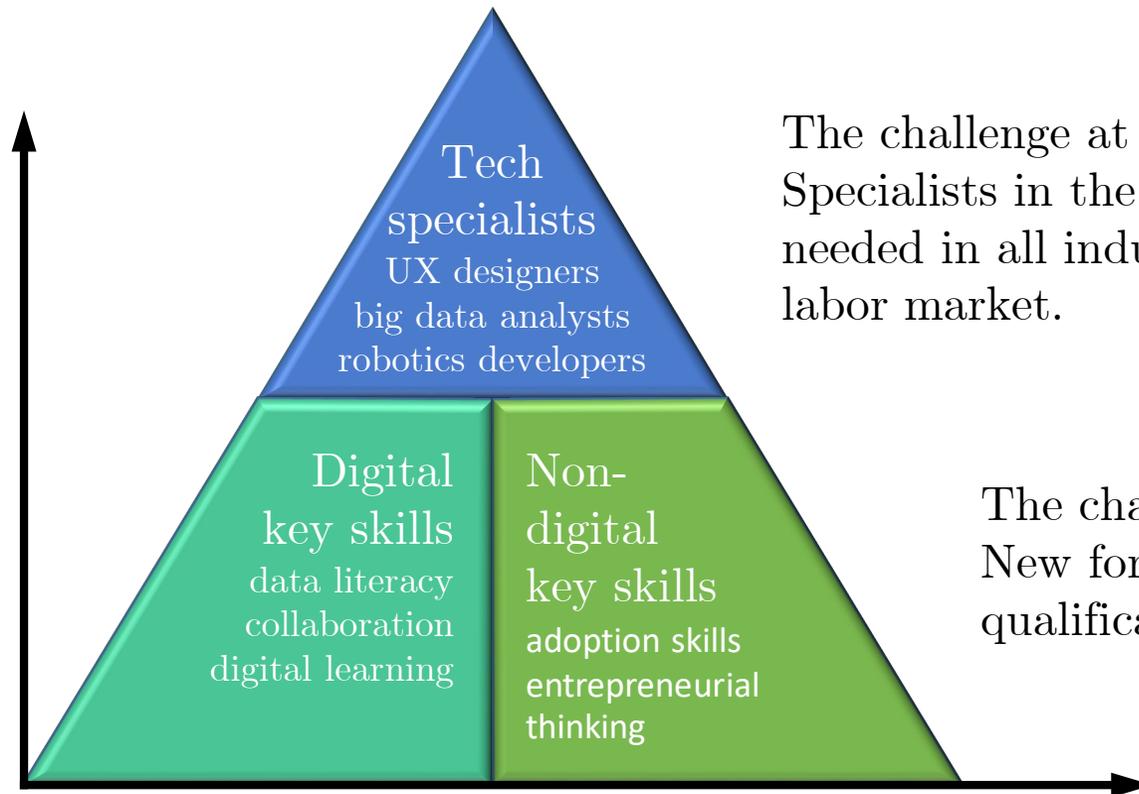
taxonomy levels



BLOOM [1956]

ANDERSON, KRATWOHL [2001]

What are “future skills“?



The challenge at the top:
Specialists in the use of transformative technologies are needed in all industries and are a scarce resource in the labor market.

The challenge across the board:
New forms of work require a modified set of key qualifications for all employees.

J. Kirchherr, J. Klier, C. Lehmann-Brauns and M. Winde. Future Skills: Welche Kompetenzen in Deutschland fehlen [online]. Essen: Stifterverband für die Deutsche Wissenschaft e.V.

<https://www.stifterverband.org/medien/future-skills-welche-kompetenzen-in-deutschland-fehlen>, 2018

What are “future skills“?

Technological skills

- Complex data analysis
- Smart hardware/ robotics development
- Web development
- User eXperience Design (UXD)
- Design and administration of networked IT systems
- Blockchain technology development
- Tech translation

Basic digital skills

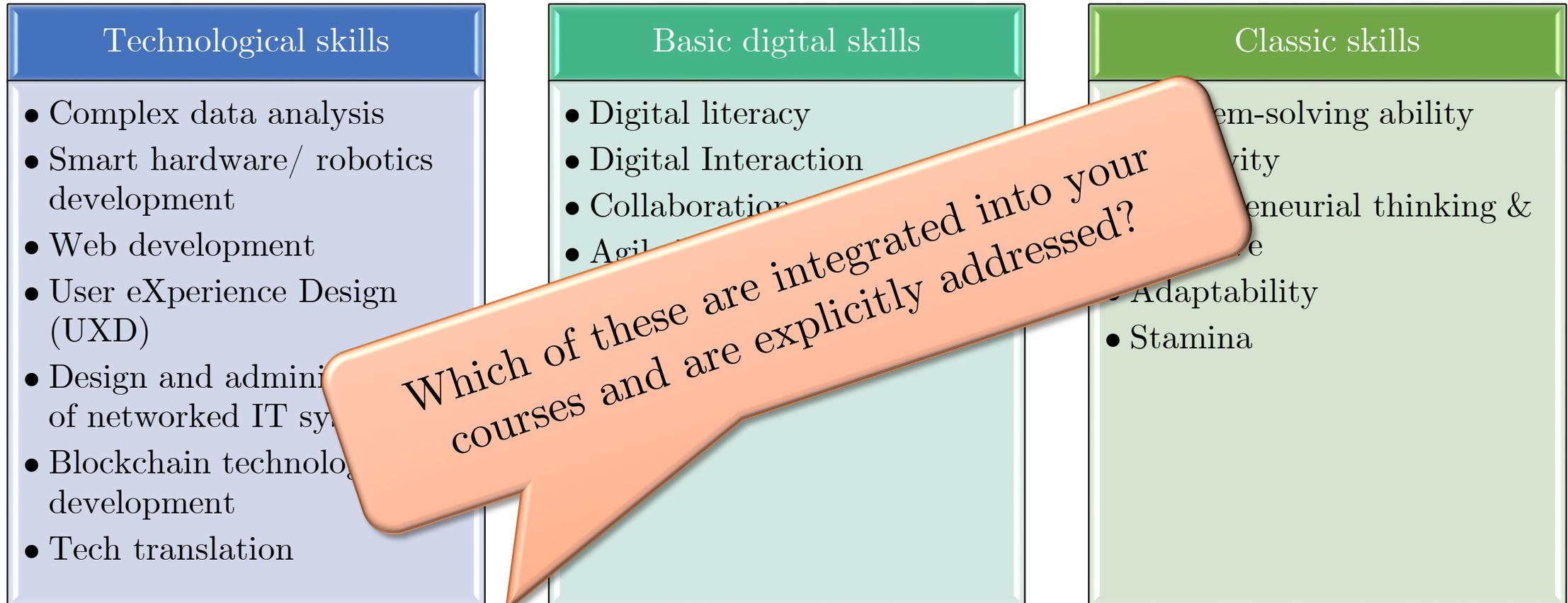
- Digital literacy
- Digital Interaction
- Collaboration
- Agile Working
- Digital Learning
- Digital Ethics

Classic skills

- Problem-solving ability
- Creativity
- Entrepreneurial thinking & initiative
- Adaptability
- Stamina

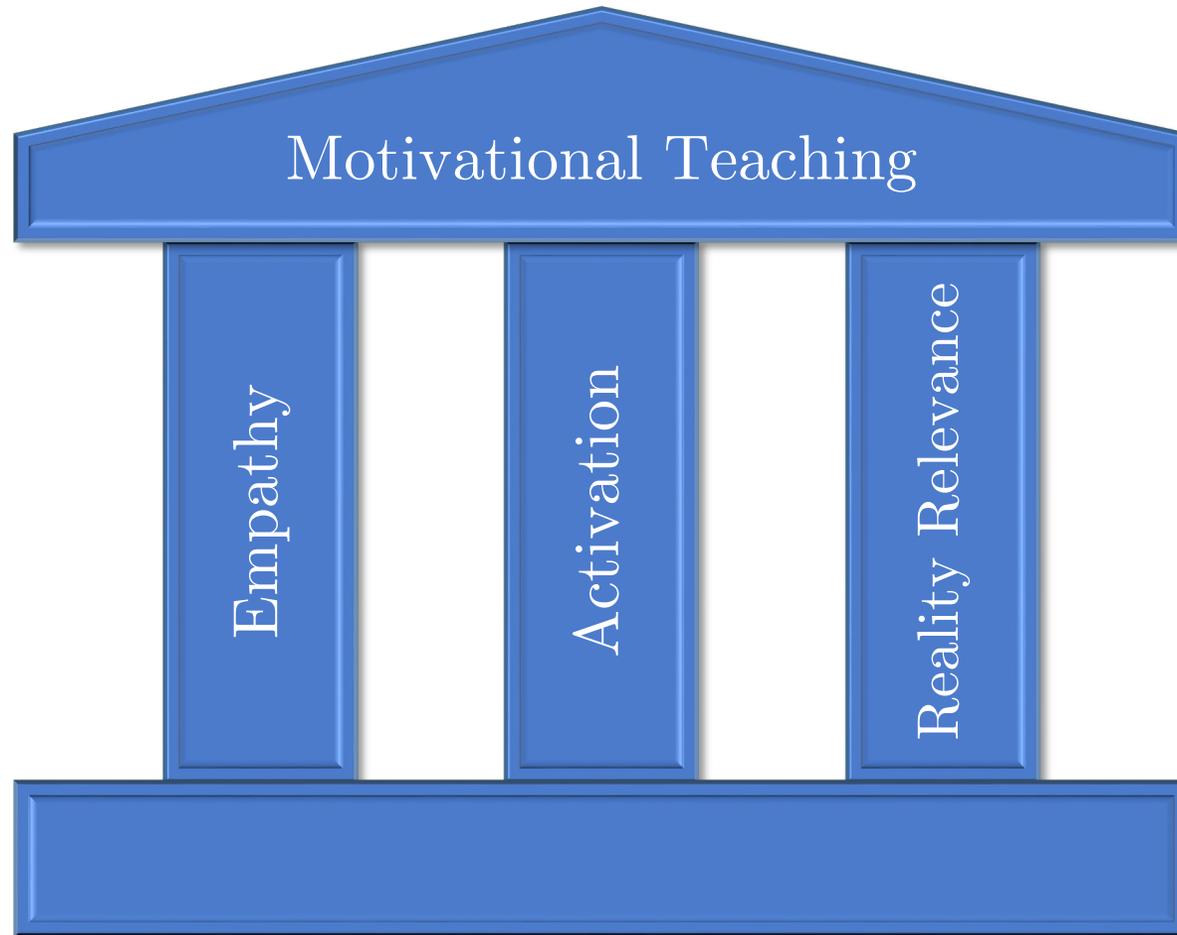
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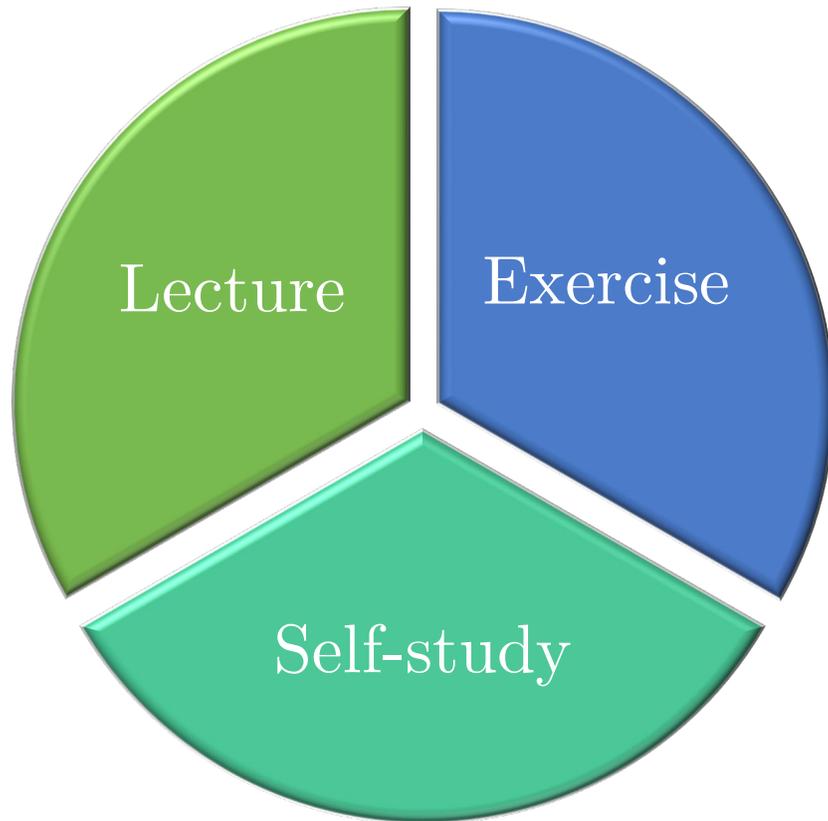
Motivational teaching



Empathy:

- Don't follow the "blame the students" attitude
- Don't take yourself as a standard
- The majority of students do not "function" the way you do
- Take students and in particular their problems seriously

Student activation



Disadvantages

- The individual parts are usually insufficiently coordinated
- Lecture content is often irrelevant to the tasks in the exercises
- In particular, the lecture contributes little to passing the exam
- Exercises teach at most how to memorize the solutions of others
- Students are mostly left to their own devices in their self-study and receive no direct support

Student activation

Comprehensive learning units

- Specifically defined learning objectives
- Including teaching and learning activities
- Limited number of “chunks“

Introduction/ Motivation

Surveys with ARS*

Theoretical foundations

DEMO unit

Do-It-Yourself (DIY) unit

*Audience Response System

DIY units



Requirements

- Specifically designed problems
- Sufficient personnel
- Empathy
- Communication skills
- No fear of making contact

Advantages

- Students are virtually “forced” to deal with problems directly and independently and to find their own solutions
- Students can ask questions directly
- Students recognize that teachers care about their learning success
- Students can continuously monitor their learning progress
- Students can continuously achieve learning success
- Teachers can immediately clear up basic misunderstandings
- Teachers can see which comprehension problems still prevail and can address them in a targeted manner
- Time in the lecture hall becomes “quality time”, which, among other things, directly serves as exam preparation

Reality relevance

Imagine you want to learn to play the guitar...



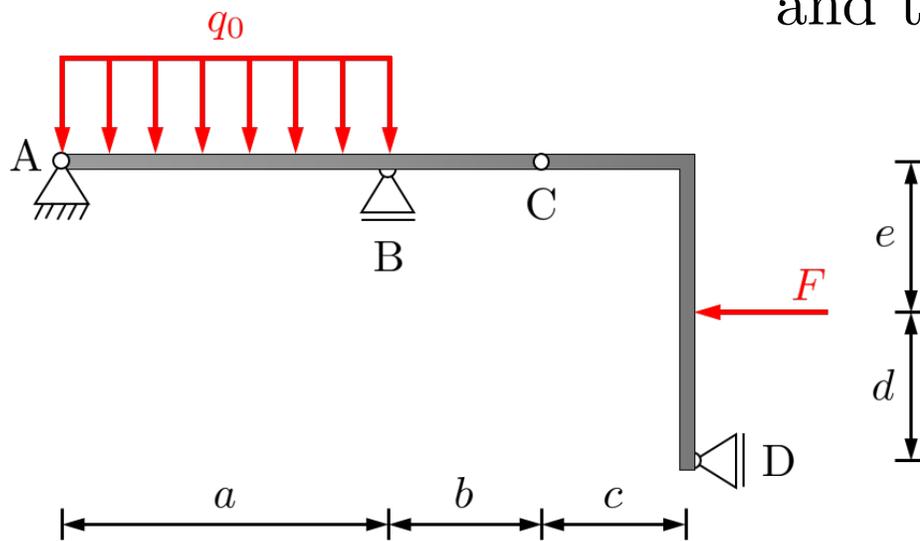
and your music teacher claims that he can easily demonstrate and explain the basics such as chords, scales and harmonies on the piano. What would you think?

Well, but I would like to play the **guitar**.

Reality relevance

Now imagine that you are studying to become an engineer...

and the problems to be solved are as follows:



Calculate the reaction forces as well as the functions of the stress resultants in this system.

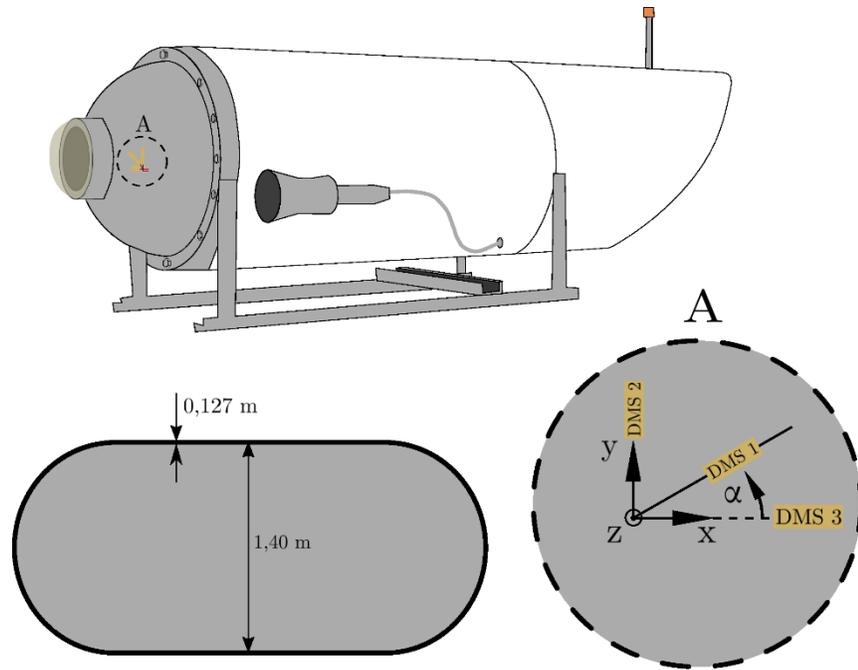
What is this supposed to be?

What does it have to do with my desired profession?

Why should I do this?

Reality relevance

Application- and competence-oriented problems



https://en.wikipedia.org/wiki/Titan_submersible_implosion

- Real-life examples with data as realistic as possible
- Put students in the shoes of experts
- Investigation of a structural failure that occurred in reality

Questions such as:

- How could this happen?
- What exactly could have been the reasons for the structural failure?
- Or was it perhaps an unforeseeable disaster after all?

Motivational teaching



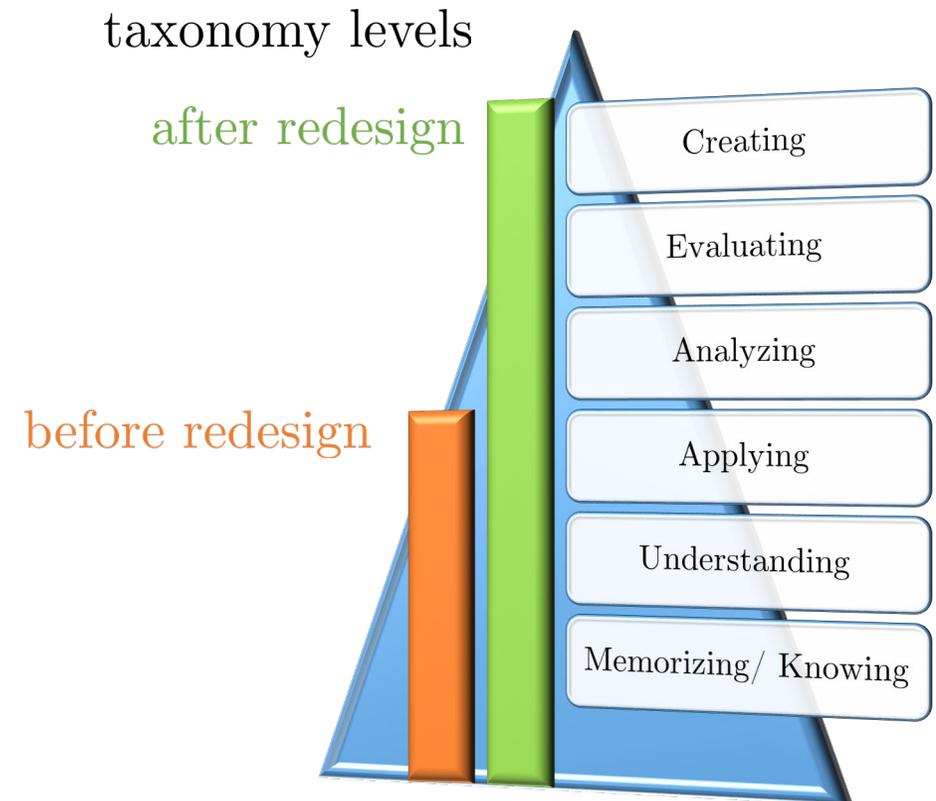
1. Keep monologues to a minimum
2. Always include elements that actively involve the students
3. Let students find solutions and do calculations themselves
4. Actively support students without giving away too much
5. Monitor and take into account students' learning progress
6. Give yourself and the students enough time in relevant places
7. Don't anticipate everything, let students think for themselves
8. Consistently omit aspects that are not relevant for the exam
9. Do not make excessive demands on content (less is more)
10. Do not set the transfer requirements too high
11. Always refer back to real-life problem cases and applications
12. Always remind students of the "big picture"
13. Clearly communicate your own expectations
14. Clearly define the learning objectives

Conclusion

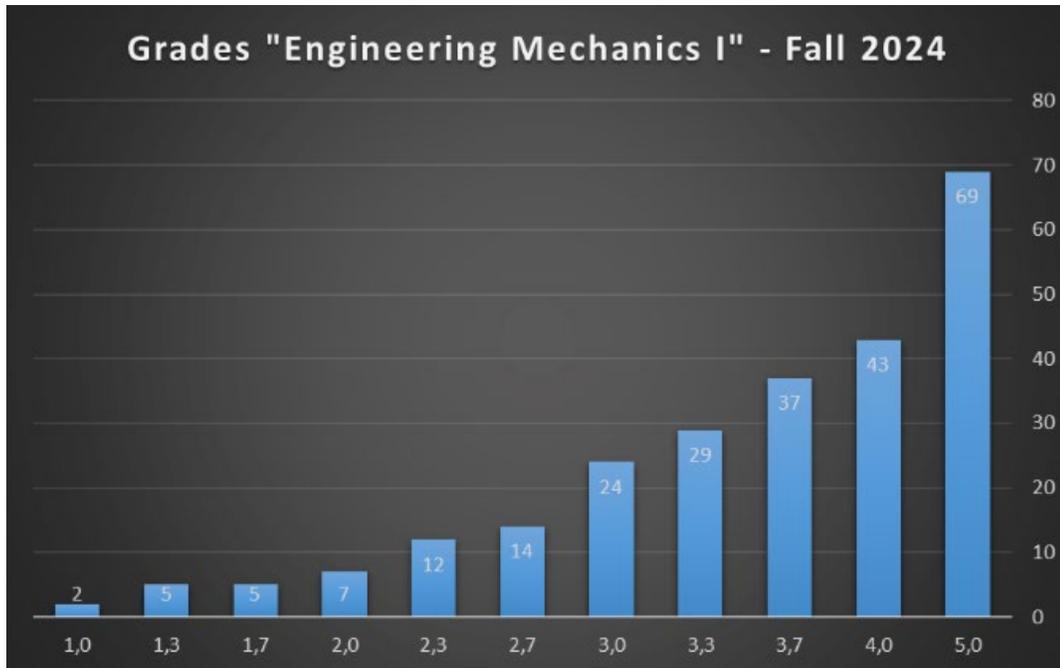
Proving that didactics lead to improvements is very difficult to do...

... because redesigning a course usually entails a significant change in taxonomy levels.

Therefore, there can be no “fair” and, above all, quantitative comparison.



Conclusion



“Service” lecture:
mechanics for

- industrial engineers
- biology and chemical engineers
- Logistics
- applied computer science
- teaching degree programs
- ...

- Grade distribution remains similar (despite higher requirements)
- The complete range of grades is covered
- Only 28% failed the exam – way better than a couple of years ago (>50%)

Conclusion

- Modern didactic concepts are the key to achieving “future skills”
- “Motivational teaching” is an elementary basis
- A paradigm shift is urgently needed:
“Shift from teaching to learning”
- The modern role of teachers is not to be “knowledge brokers”, but didactically trained moderators
- If the effort required to make the change seems too great... collaborate with us!

