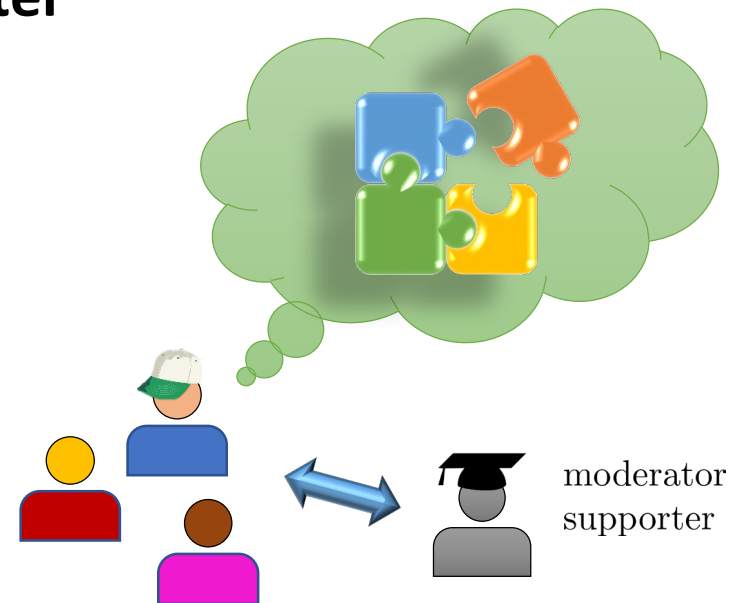
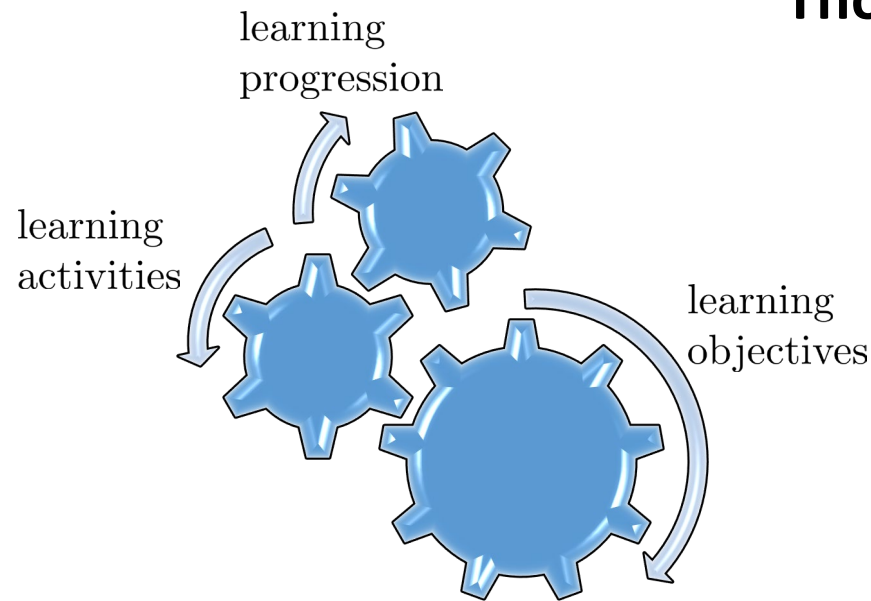


Basic concepts of didactics and examples competence-oriented implementation

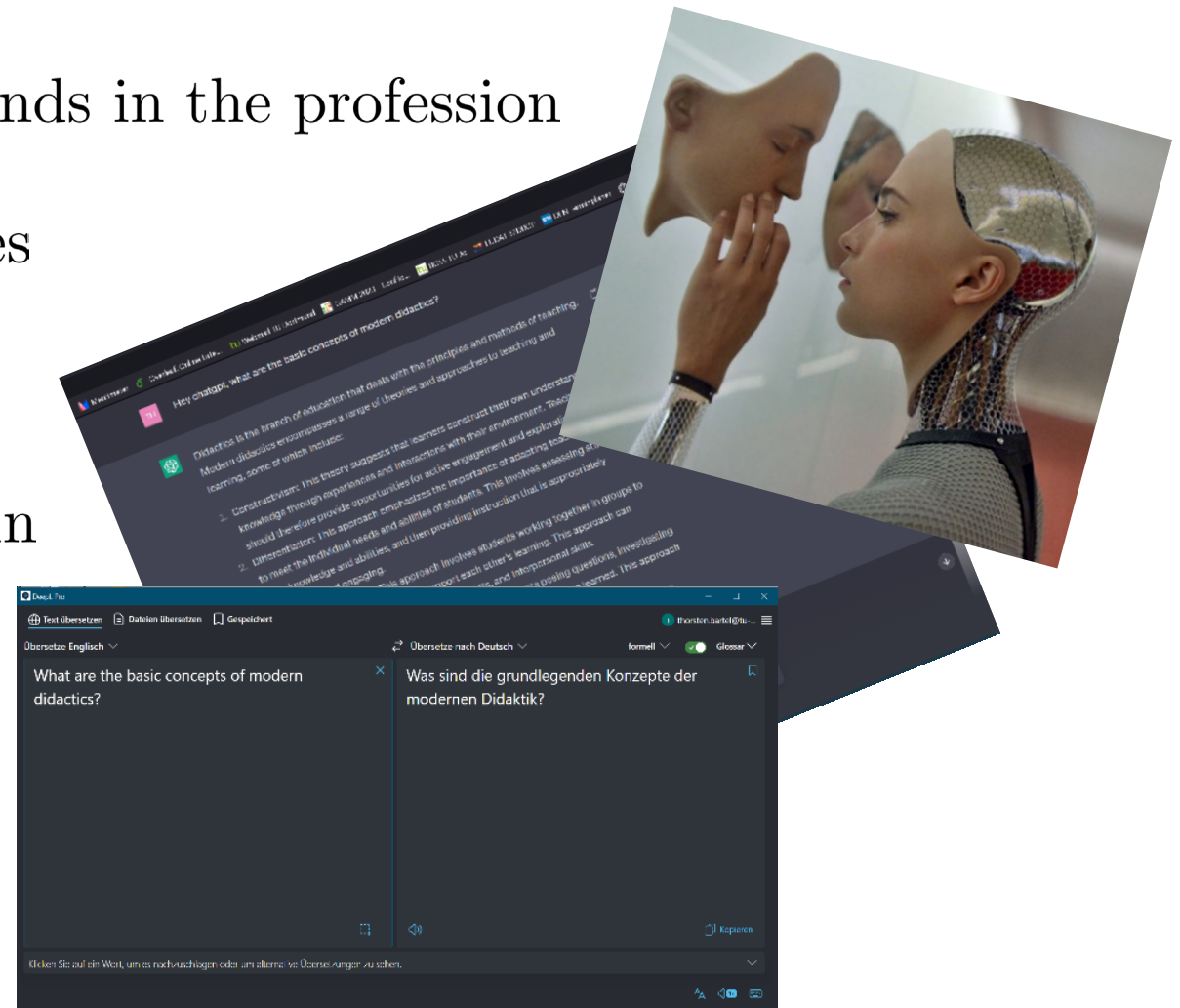
Thorsten Bartel



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Why bother with didactics?

- Rapidly and strongly increasing demands in the profession
- Increased need for higher competencies
- Strong increase in student numbers
- ...and, as a result, a strong increase in the heterogeneity of students



Common misconception

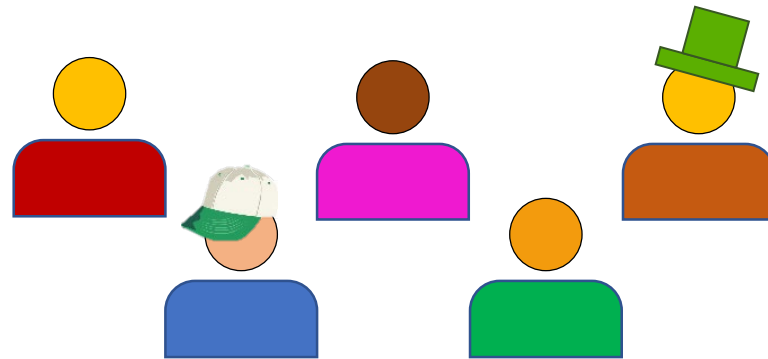
“Didactics has the goal of making the course of study more school-like, thereby lowering the requirements in order to allow as many students as possible to graduate.”



Quite the opposite: The goal of didactics is to enable the **majority** of students to achieve **higher** and **contemporary** competencies despite the pronounced **heterogeneity**.



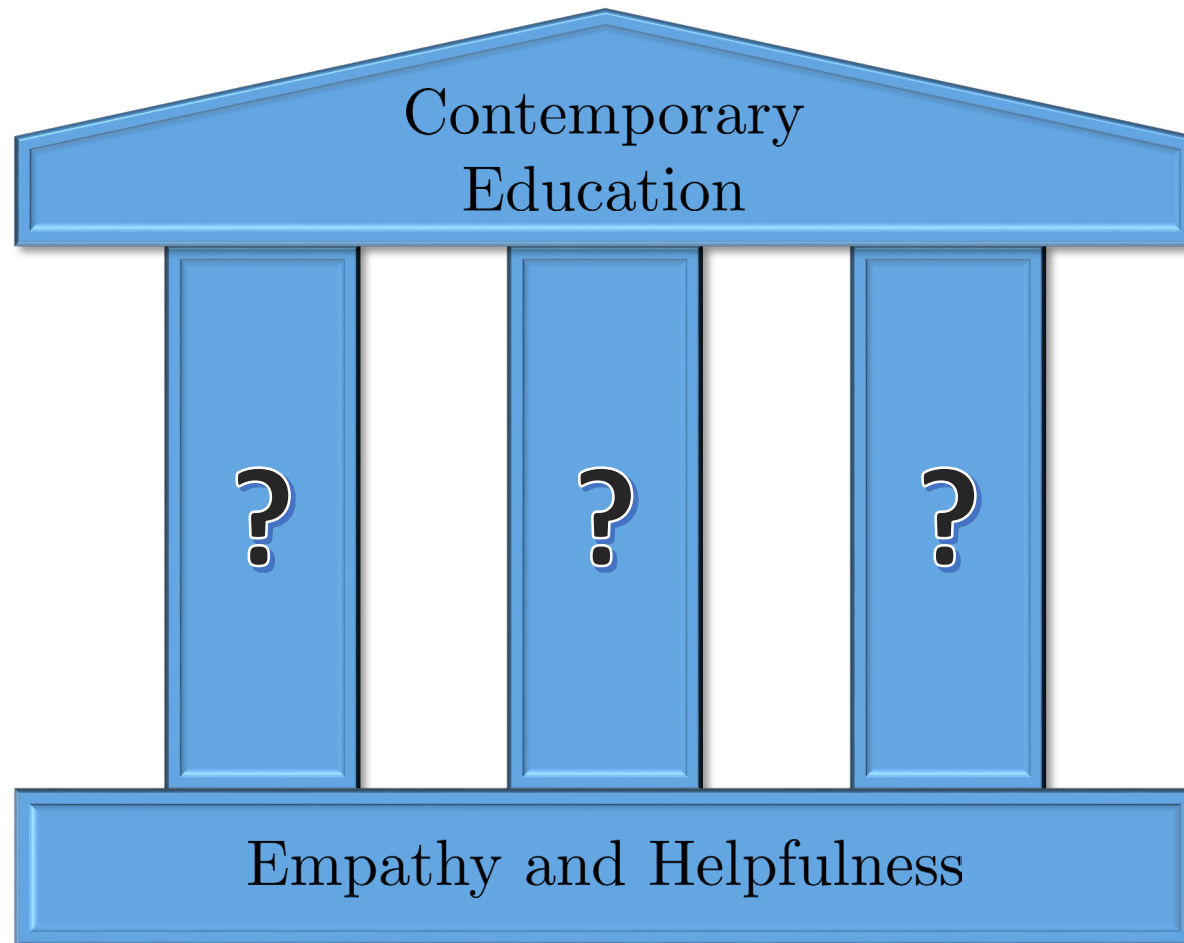
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Diversity concerning

- prior knowledge
- intrinsic self-motivation
- individual learning speed
- ...

Conception of a contemporary education



- Please do not follow the “blame the students” attitude
- Do not take yourself as a standard
- The majority of students do not “function” the way you do
- Take students seriously

Learning objectives

In this module, we cover numerical integration methods of the Runge-Kutta type



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In this module, we cover numerical integration methods of the Runge-Kutta type

Students independently derive the differential equations of the double pendulum and transform them into a system of first order differential equations. On this basis, the students write a program in Python and solve the differential equation system using the Runge-Kutta type methods available there. ...

Learning objectives

In this module, we cover numerical integration methods of the Runge-Kutta type



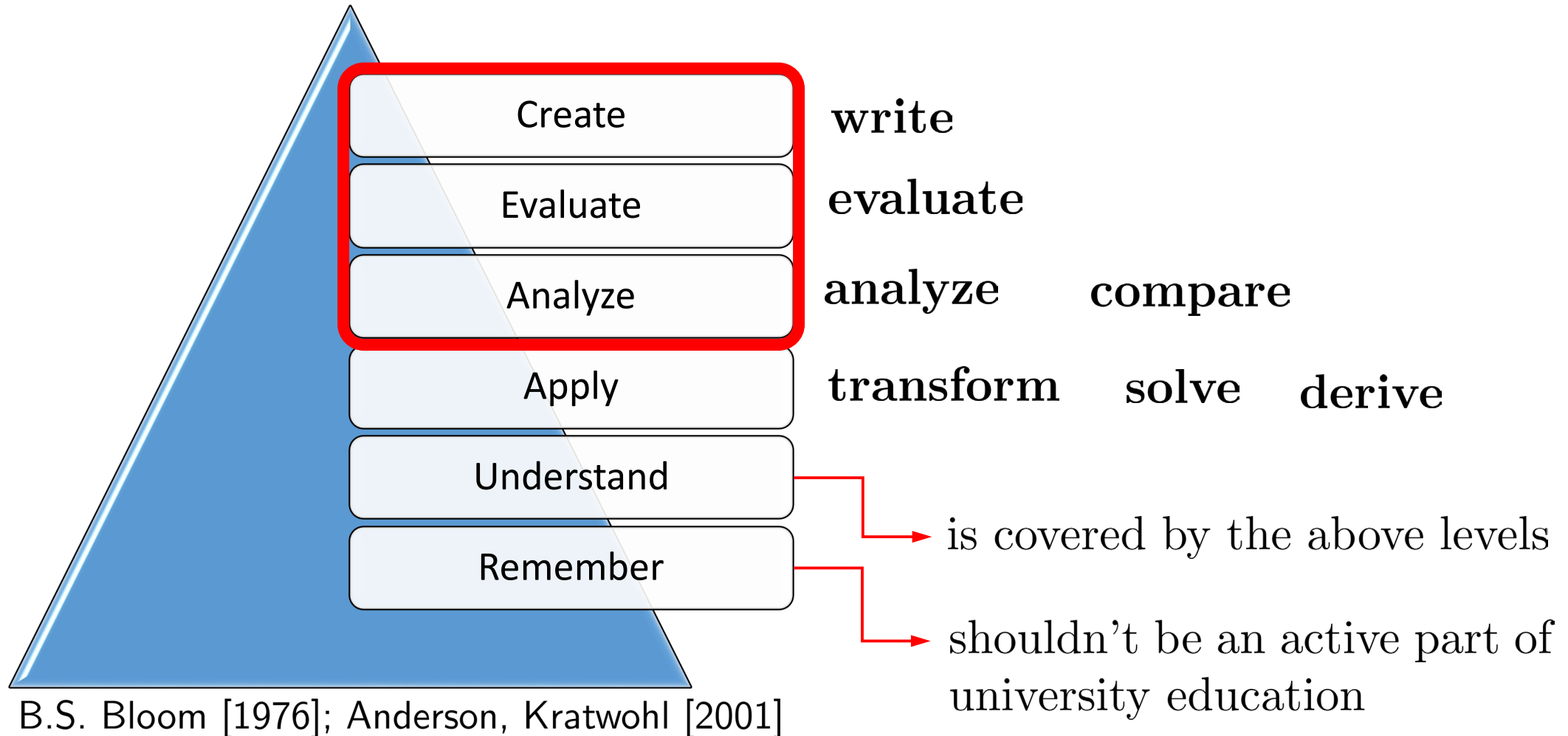
...The students independently analyze the results obtained with the different methods with respect to their respective advantages and disadvantages. Through appropriate comparisons, the students evaluate the methods with respect to relevant criteria.

Learning objectives

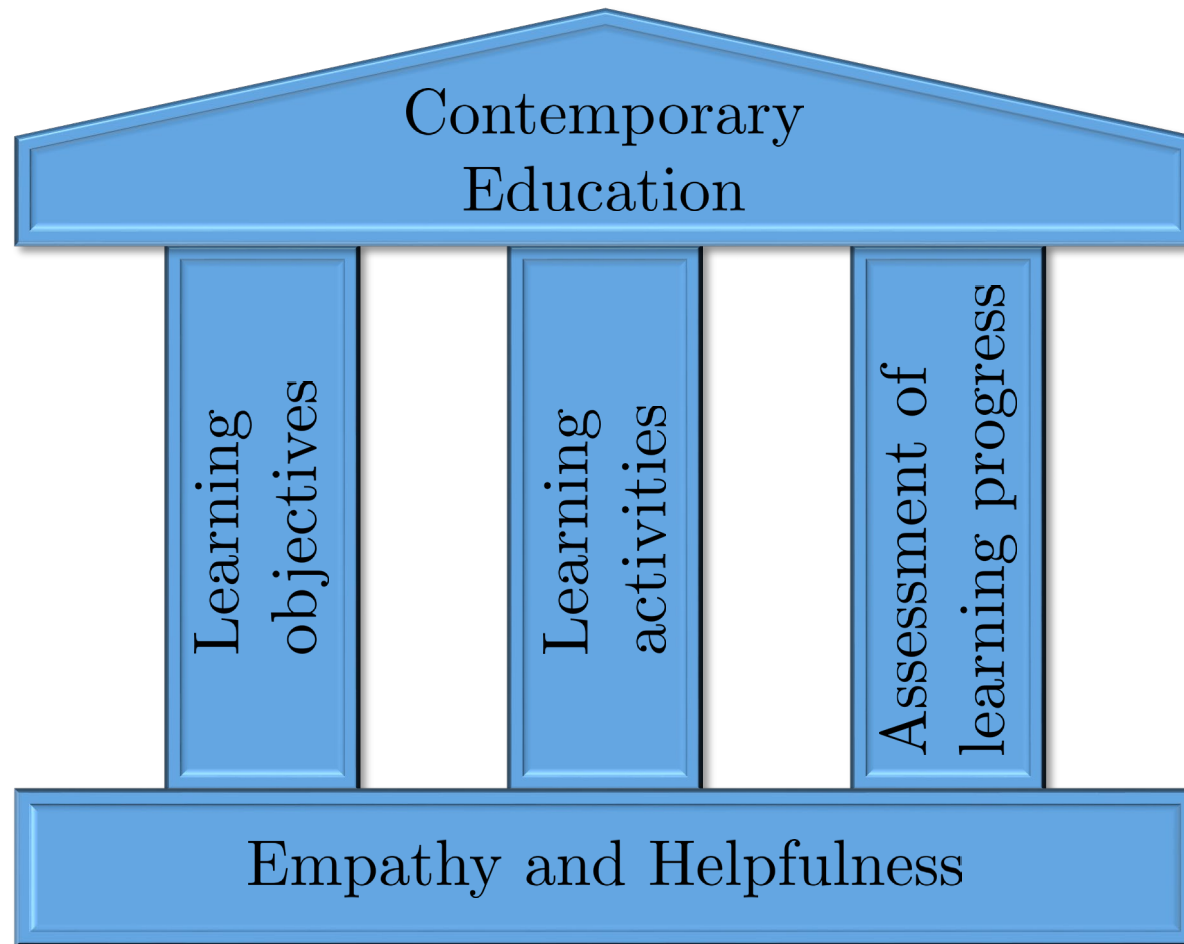
Students independently **derive** the differential equations of the double pendulum and **transform** them into a system of first order differential equations. On this basis, the students **write** a program in Python and **solve** the differential equation system using the Runge-Kutta type methods available there. ...

...The students independently **analyze** the results obtained with the different methods with respect to their respective advantages and disadvantages. Through appropriate **comparisons**, the students **evaluate** the methods with respect to relevant criteria.

Taxonomy levels

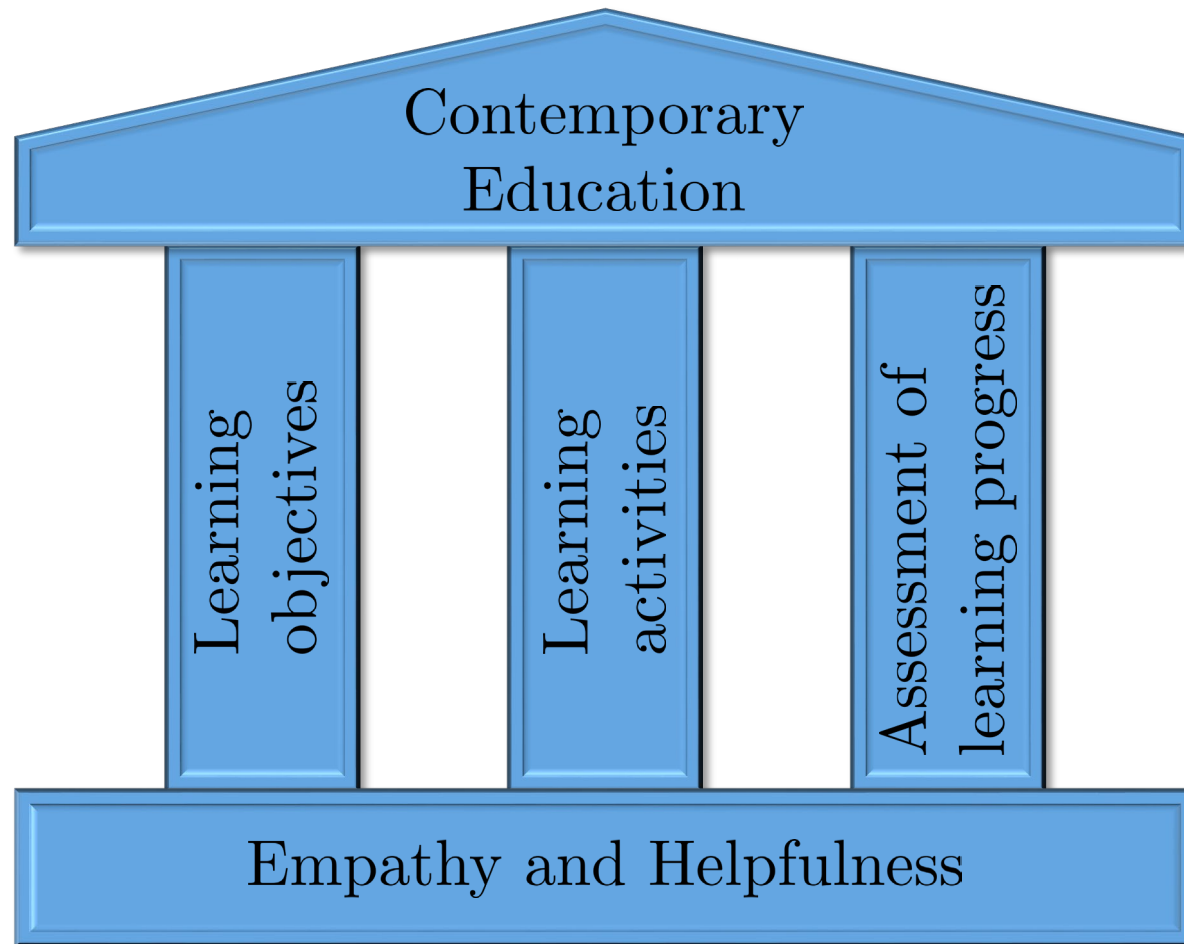


Conception of a contemporary education



- What knowledge, skills, and competencies should students acquire at which taxonomy levels?
- What learning and teaching activities are necessary to achieve the learning objectives?
- Learners must always be able to assess their own learning progress, just as teachers must monitor and respond to learners' progress.

Conception of a contemporary education



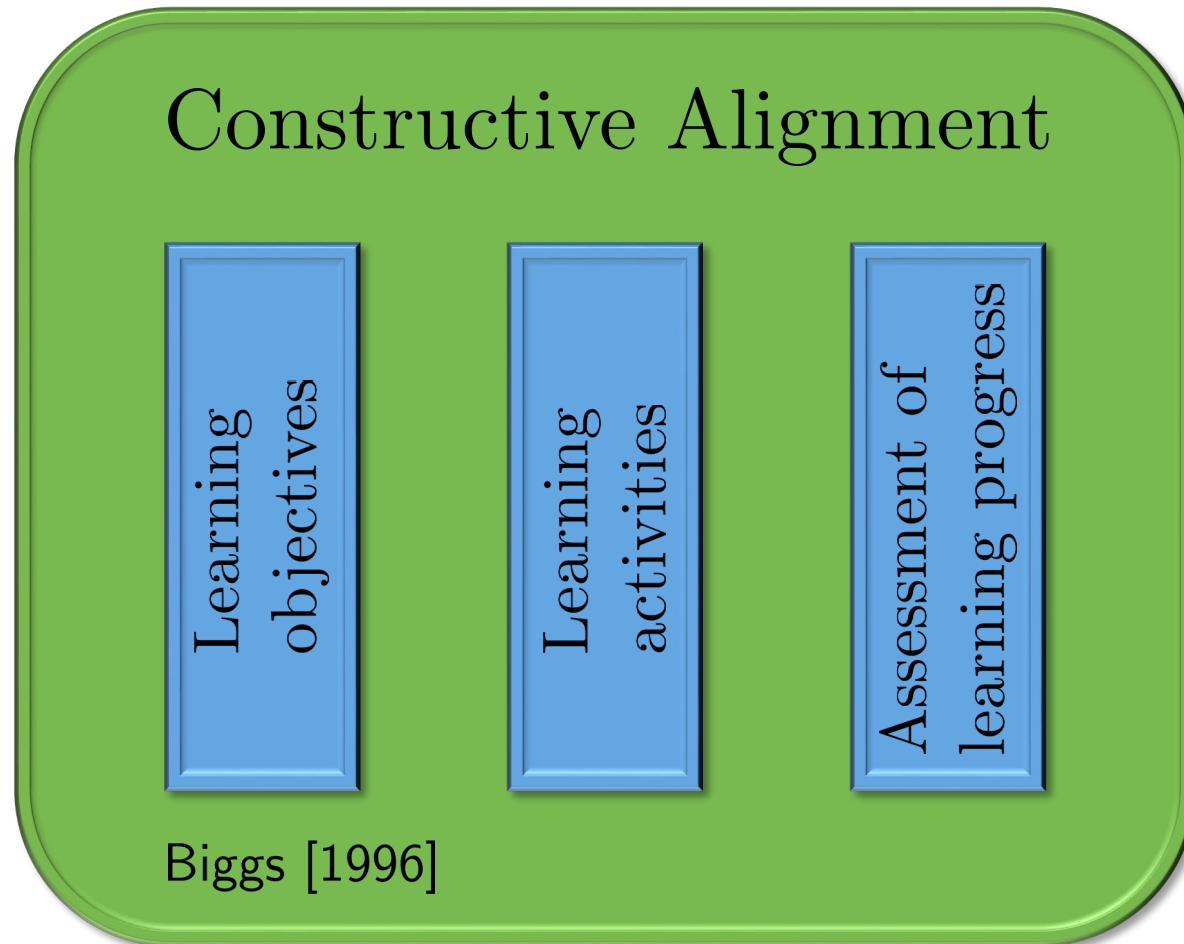
Are you interested?

Do you need support?

Very gladly...

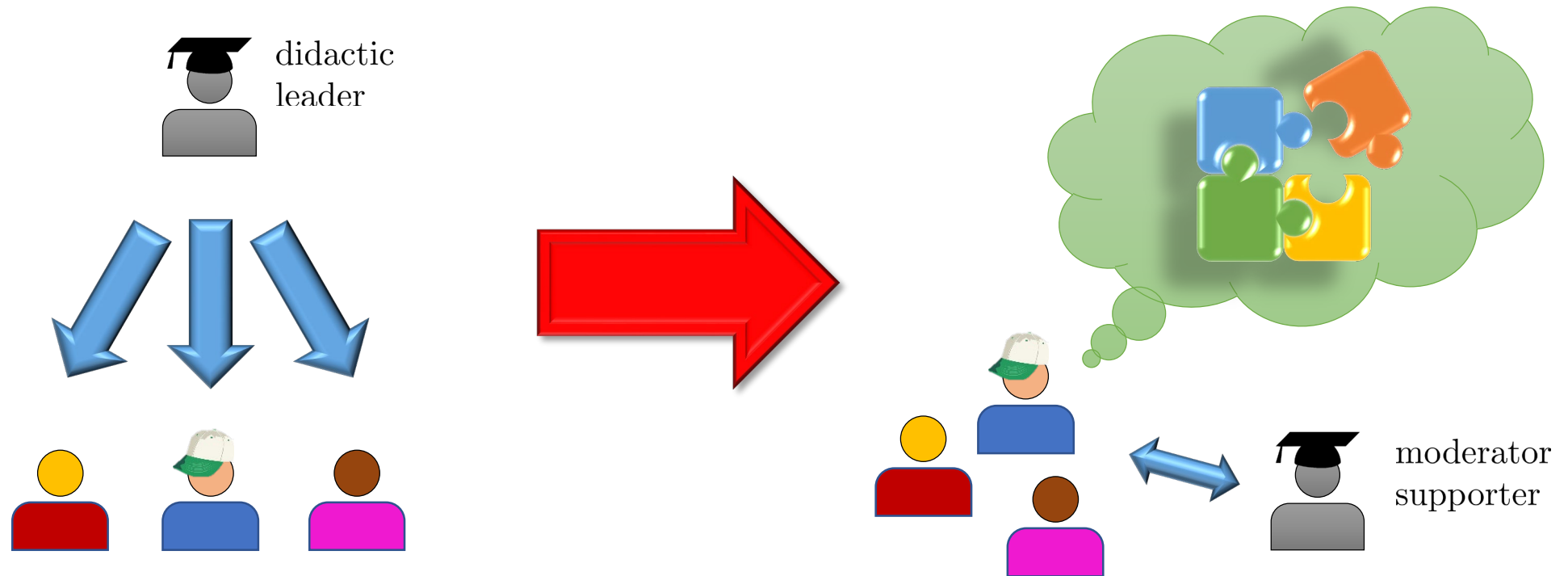


Conception of a contemporary education



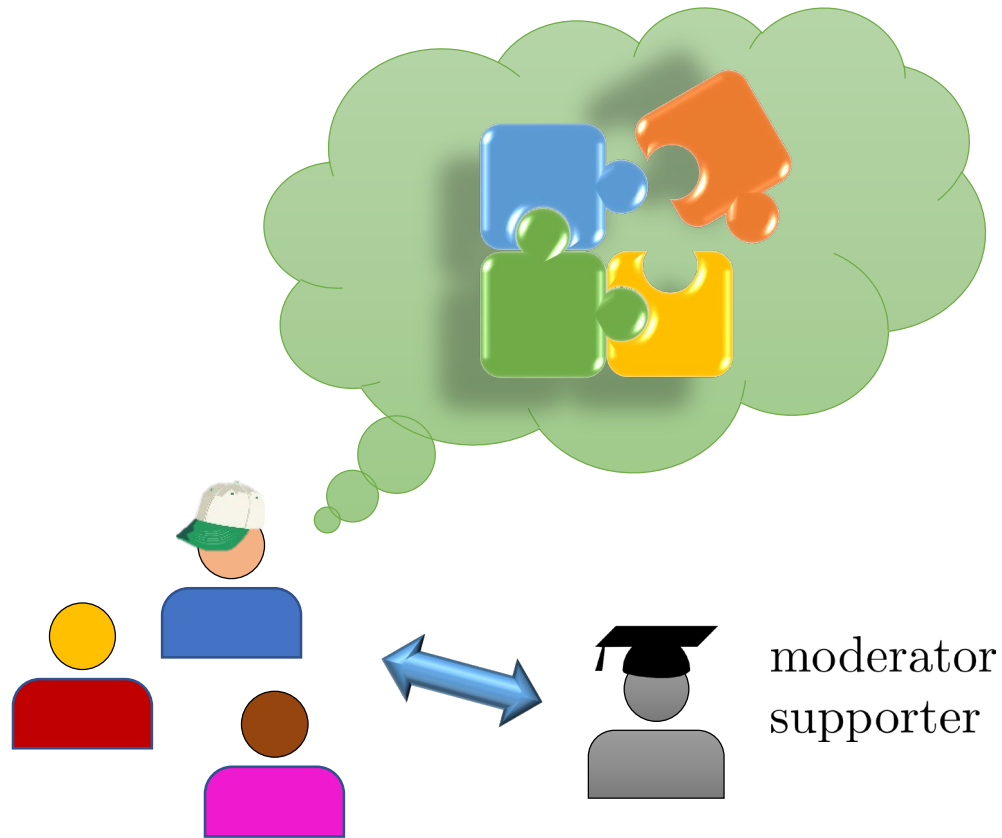
- All teaching and learning activities must consistently pursue the goal of achieving learning objectives ...
- ...and these can only be achieved if they are tested!
- ...and this should make us think whether the current form of examination is really useful.

What should teaching mean?



We need to make the shift from teaching to learning!

Constructivism



Modern role of teachers:

- Providing learning opportunities
- Creating situations that are as authentic and relevant to learners as possible
- Encouraging independent solution of problems
- Joint reflection on newly acquired knowledge

Application example #1

Fully asynchronous learning environment

- currently used for Machine Dynamics, Nonlinear Continuum Mechanics
- instructional videos (total length: ≈ 5 h)
covers mostly taxonomy levels Remember and Understand
- problems \Rightarrow **Optimal exam form!**
Semester-accompanying homework assignments; Students (try to) find solution paths; We provide feedback to the submitted digital documents.
covers mostly tax. levels Apply, Analyze, Evaluate and Create
- We offer students “quality time” on-site

Application example #2

Hybrid course, still based on constructivism

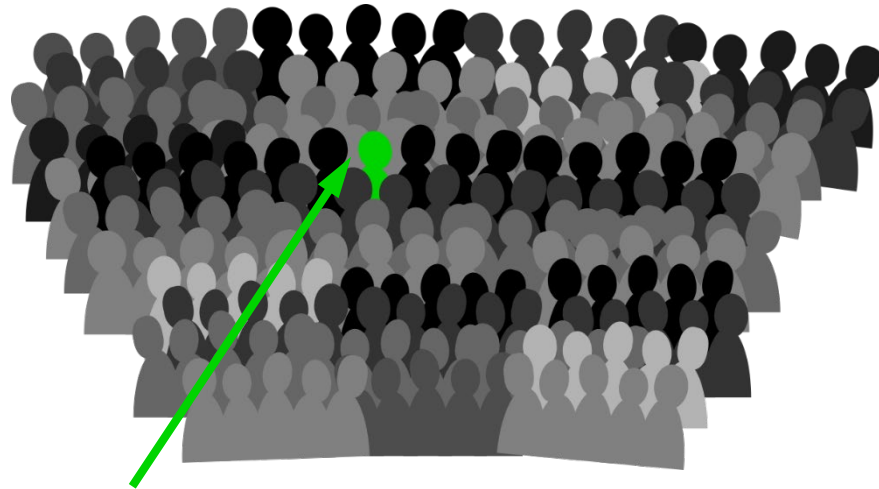
- currently used for Technische Mechanik I
(Industrial, Biological, Chemical Engineering)
- No longer a sharp distinction between lecture, exercise and tutorials
- Theoretical units followed by a demo part followed by a DIY part
- We provide assistance during the DIY units
- Tutorials remain as additional events
- However, the exam ruins a lot for us from a didactic point of view

Another common misconception

“At universities, we are educating primarily for science!”

Two perhaps provocative questions:

Does that actually make sense? And if so, do you really succeed?



Is this our target group?

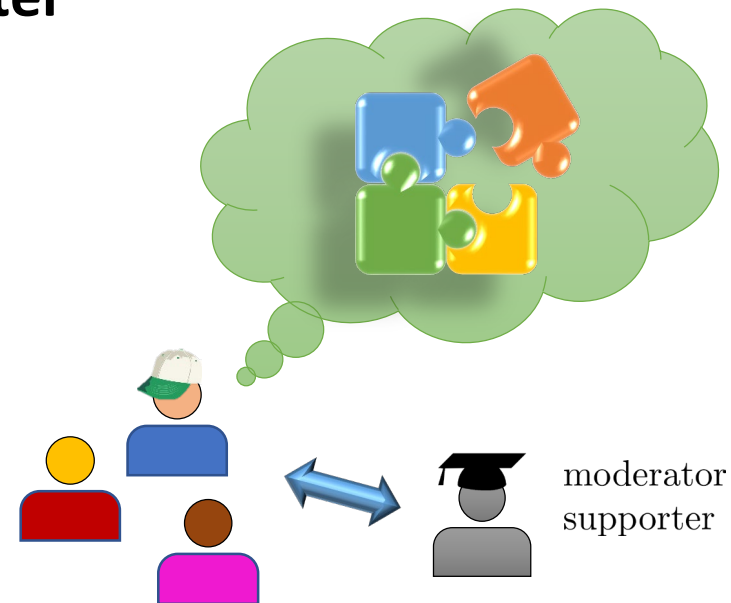
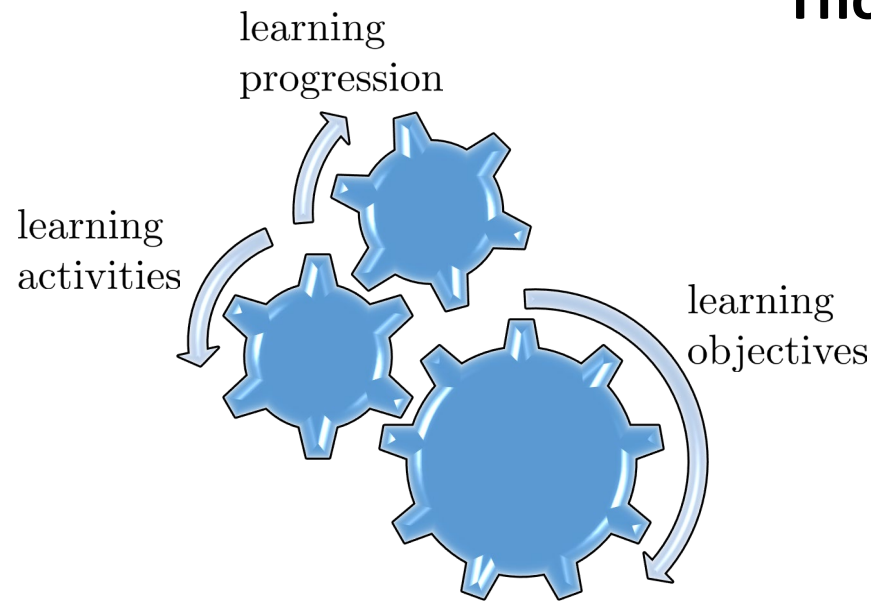
Usual activities in science:

- Finding niches in the state of research
- Developing own ideas
- Writing papers
- Writing research proposals

Are your Ph.D. students well prepared for this?

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