

# Three-Level System for Teaching Mathematics in Engineering

Milena Sipovac, Corinna Modiz,  
Stefanie Winkler, Andreas Körner

18.06.2021

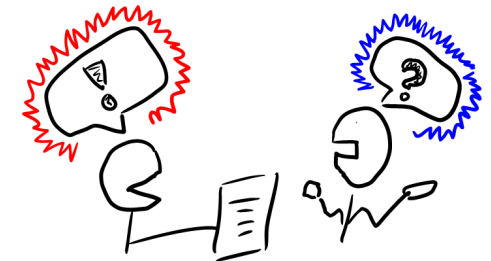
---

- Introduction and the main idea
- Structure of the course and requirements
- What is new here?
- Data discussion: 2019 vs. 2020
- Data discussion: Master class attempt vs. no attempt
- Data discussion: Final exam
- Conclusion and outlook

- Introduction and the main idea
- Structure of the course and requirements
- What is new here?
- Data discussion: 2019 vs. 2020
- Data discussion: Master class attempt vs. no attempt
- Data discussion: Final exam
- Conclusion and outlook

- A new approach
- Introductory mathematics
- Möbius E-Learning Tool
- Students of electrical engineering, physics and geodesy
- Constructive alignment
- Inhomogenous groups with different mathematical backgrounds

möbius

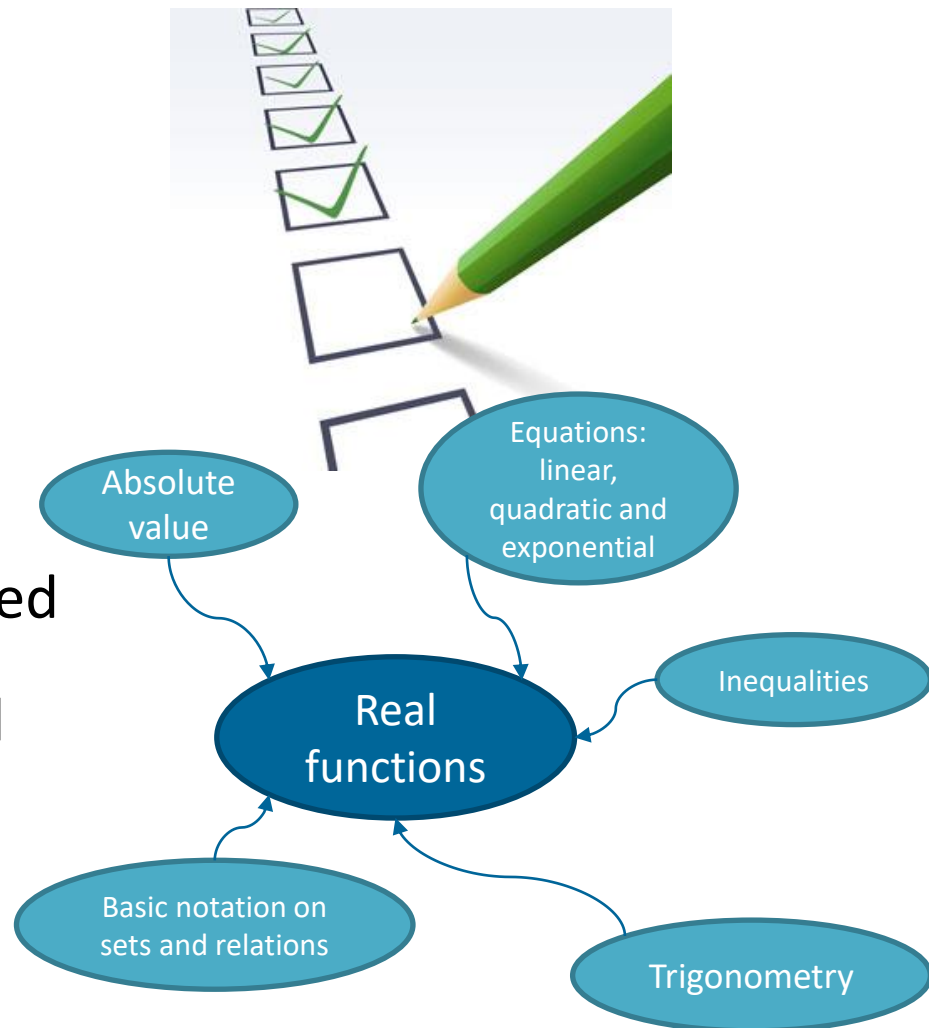


- Introduction and the main idea
- **Structure of the course and requirements**
- What is new here?
- Data discussion: 2019 vs. 2020
- Data discussion: Master class attempt vs. no attempt
- Data discussion: Final exam
- Conclusion and outlook

- Students from three different fields of studies
- Level 1: basic knowledge -> 90% required
- Level 2: regular exercise sessions -> 60% required
- Level 3: master class -> bonus points
- Tests (mid-term)

# Level 1: basic knowledge

- Must be completed by every student
- Preparation for the topic with materials that should be already familiar
- Assignments in Möbius
- Assignments can be repeated as often as needed
- Each time an assignment is started from the beginning – a randomised version is presented to the student
- **Goal: clear communication of course requirements**



# Level 2: regular exercise problems

---

- Completed as a homework
- Discussed during exercise sessions
- Two attempts
- Follows the material covered during the lecture in the week before
- Prevents the students from cramming
- 2019: Solutions presented on the blackboard
- 2020: Zoom sessions with screen sharing
- **Goal: cover and practice the topics from the lecture**





- Broadening the knowledge
- Connecting seemingly unrelated topics
- Not obligatory
- Students construct their own examples to a given idea and present them in individual discussions with a teaching assistant
- **Goal: provide an opportunity to gain the „big picture“ of the course**



- Introduction and the main idea
- Structure of the course and requirements
- **What is new here?**
- Data discussion: 2019 vs. 2020
- Data discussion: Master class attempt vs. no attempt
- Data discussion: Final exam
- Conclusion and outlook

# Comparing the modi of 2019 and 2020

---

## 2019:

- Weekly assignments: corresponds to level 2
- Basic examples as well as advanced examples included in the regular sessions
- Three tests

## 2020:

- Continuous feedback during the whole semester
- A lot of exercise material for each level of knowledge
- The basic knowledge and master-class examples introduced
- The second level examples were completely focused on the lecture material: no need for „introductory“ examples, or „expert“ examples
- Less distraction from the necessary topics

- Introduction and the main idea
- Structure of the course and requirements
- What is new here?
- **Data discussion: 2019 vs. 2020**
- Data discussion: Master class attempt vs. no attempt
- Data discussion: Final exam
- Conclusion and outlook

# 2019 vs. 2020: Grade distribution

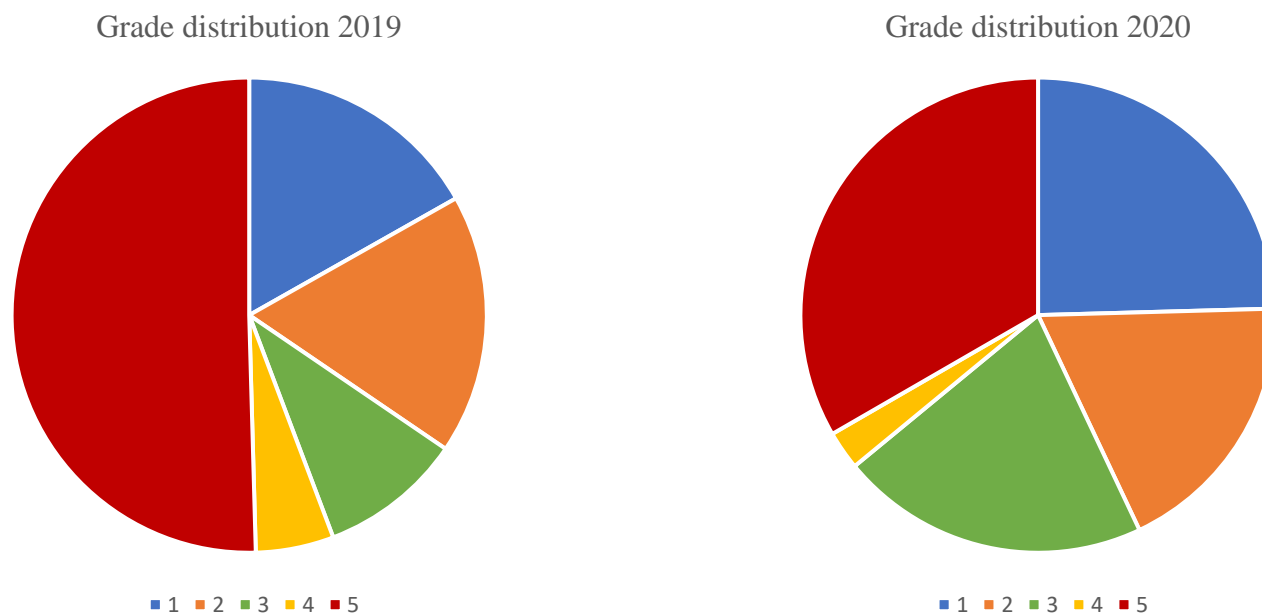
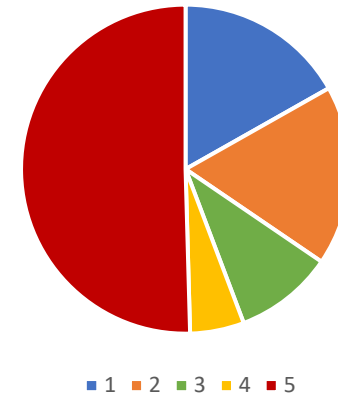


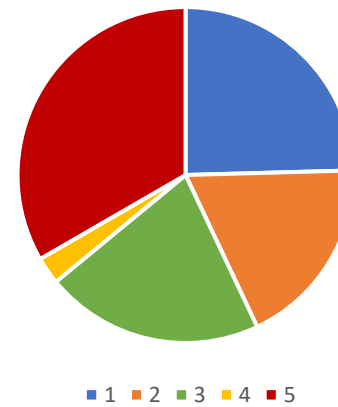
Figure 1. Grade distributions of the summer semesters 2019 and 2020

- The three level system was first introduced in 2020
- 2019: 113 students
- 2020: 114 students
- In 2020: smaller red region (33%) than in 2019 (50%) – less students failed
- In 2020: more students finished with the best grade (25%) than in 2019 (17%)

Grade distribution 2019



Grade distribution 2020



- Introduction and the main idea
- Structure of the course and requirements
- What is new here?
- Data discussion: 2019 vs. 2020
- **Data discussion: Master class attempt vs. no attempt**
- Data discussion: Final exam
- Conclusion and outlook

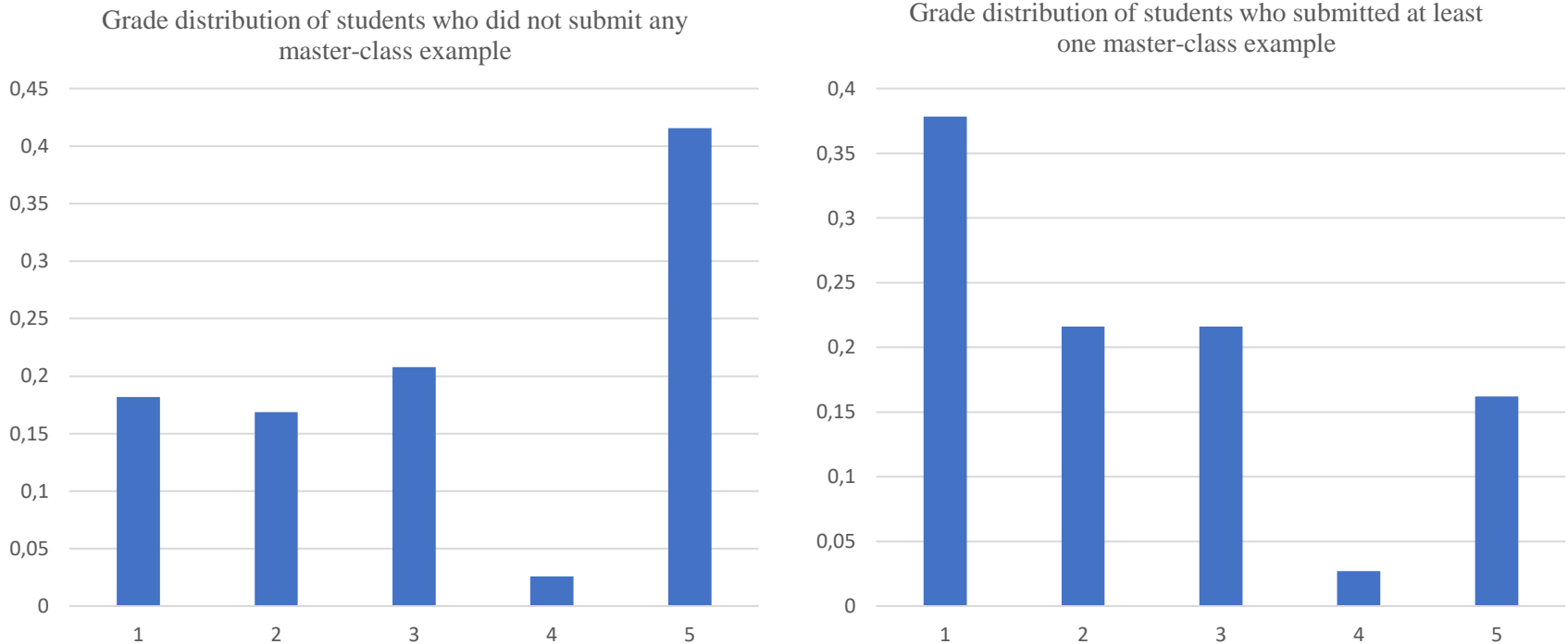
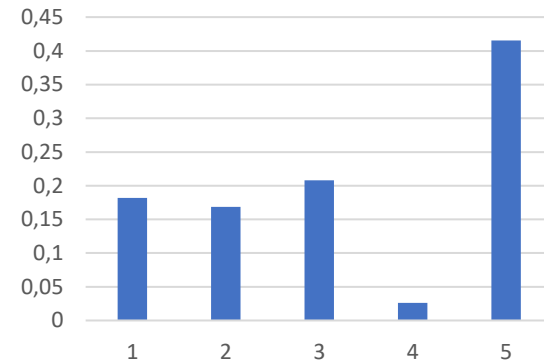


Figure 2. Grade distribution of students who did and did not participate in the master class in summer term 2020 in percentage terms.

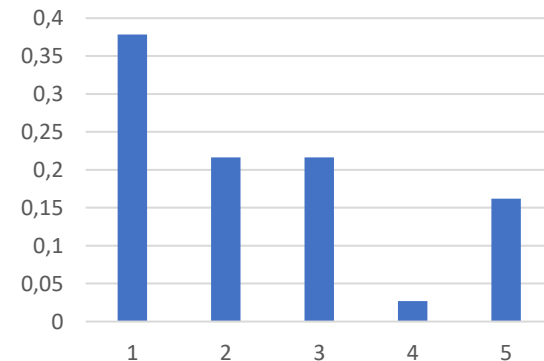


- 37 students participated in the last level
- Participant: if at least one example submitted
- Significantly better results
- Participants: 37,8% best grade, 16% failed
- Non-participants: 18,2% best grade, 41,6% failed

Grade distribution of students who did not submit any master-class example



Grade distribution of students who submitted at least one master-class example



- Introduction and the main idea
- Structure of the course and requirements
- What is new here?
- Data: 2019 vs. 2020
- Data: Master class attempt vs. no attempt
- **Data discussion: Final exam**
- Conclusion and outlook

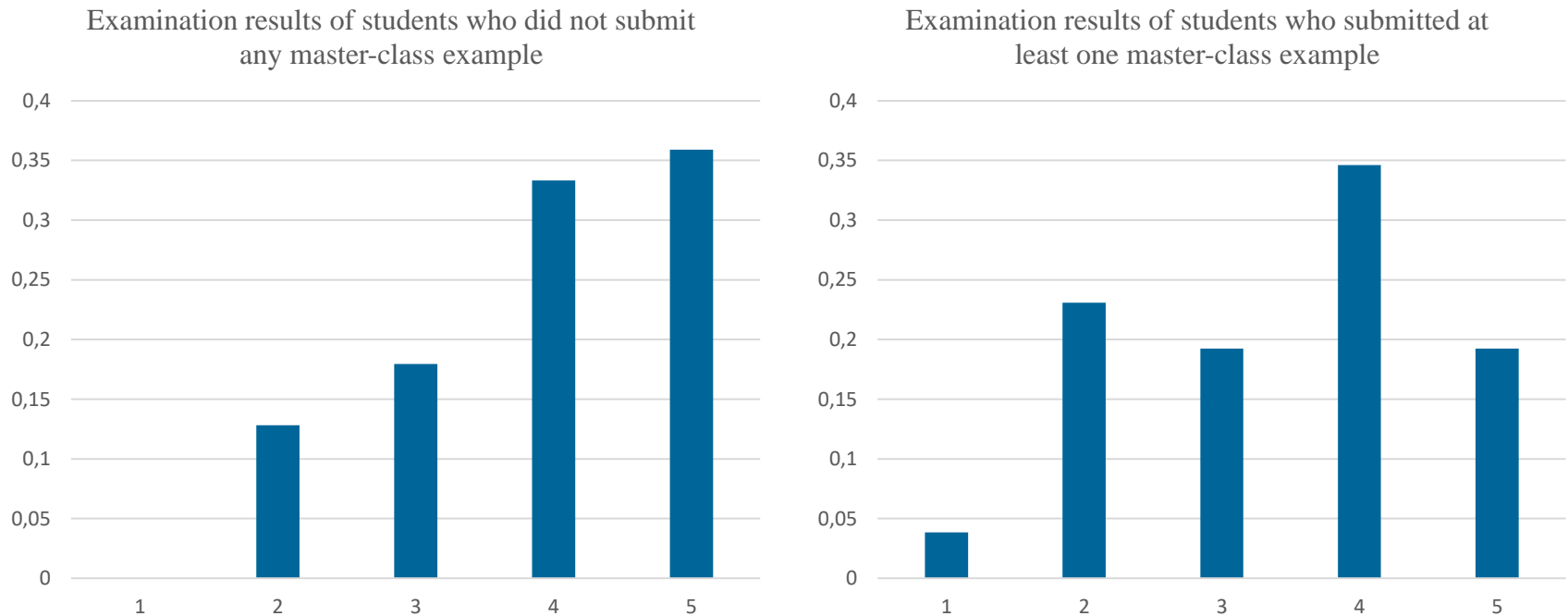
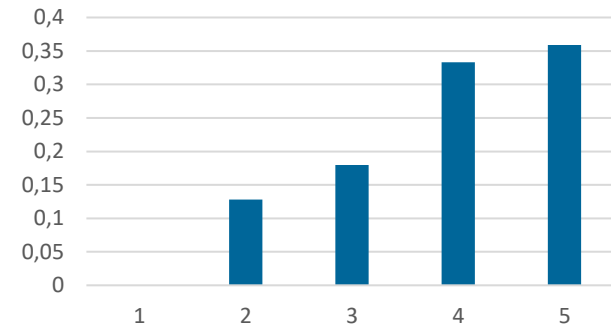


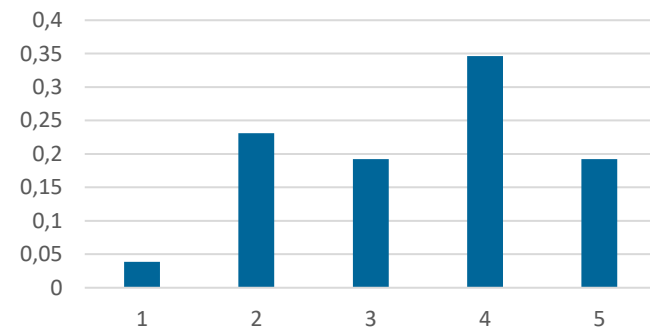
Figure 3. Grade distribution of the examination of the lecture of students who did and did not participate in the master class in percentage terms.

- 65 students took the exam at least once
- Lecture course and exercise course separated
- Final exam: students can choose to attend one of three possible examination sessions during the semester
- Participants: 20% did not pass
- Non-participants: 35% did not pass, no best grades

Examination results of students who did not submit any master-class example



Examination results of students who submitted at least one master-class example



- Introduction and the main idea
- Structure of the course and requirements
- What is new here?
- Data: 2019 vs. 2020
- Data: Master class attempt vs. no attempt
- Data discussion: Final exam
- **Conclusion and outlook**

- With basic examples: more students passed the course
- With master class examples available: more students obtained better grades
- Scoring in 2020 more comprehensible: better motivation
- Positive impact on the accompanying lecture



- Further development in 2021
- Positive feedback
- Similar method for winter term
- To be continued...
- Questions?

