Impact of Teaching Methods on Heterogeneity

Hochschule **Rosenheim**
University of Applied Sciences

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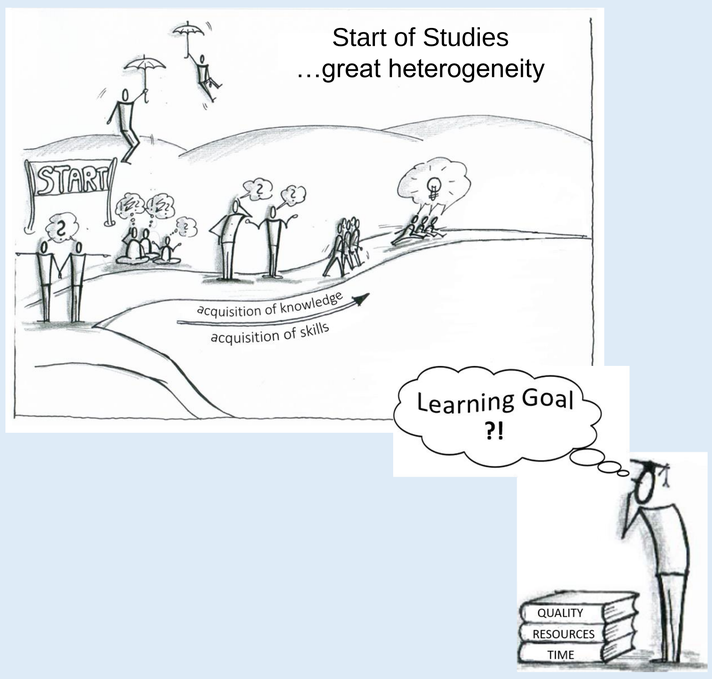


Problem

- Increasing heterogeneity of first-year students
- High dropout rates
- Students postpone learning

Project

- 6.5 years implementation projects fostering active learning methods [HD-Mint, Pro-Aktjv]
- Teaching team of three responsible professors, three additional professors, two research assistants (physics and pedagogy), technical assistance by staff.

Questions

1. Measuring the heterogeneity of beginners

2. Do the introduced and adapted JiTT/ PI/ - methods show comparable effects as reported in literature?

3. What's the impact of JiTT/ PI methods on the heterogeneity of previous knowledge?

Starting Point

- Period: 5 years (2013/14 to 2017/18)
- University of Applied Sciences, Rosenheim,
- 8 different basic Physics Courses for Engineers (1 or 2 terms) with
- 8 different lecturers
  - 3x traditional teaching methods
  - 5x JiTT/PI/ Tutorials

Analyzing Methods

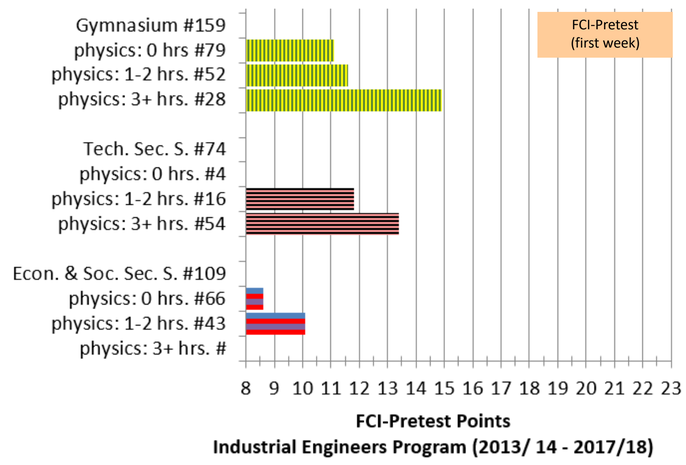
- Force Concept Inventory (FCI) [Hes92]
- Students' survey and extensive qualitative written interviews analyzed qualitatively by pedagogical research assistant (> 1000 p.)

Introduction and Adaption of Interactive-Engagement Learning Methods – Details

- Just-in-Time Teaching [Nov99 (JiTT)]:
  - one reading text/ week (= 20 reading texts in two terms) with two corresponding online tests: in advance and after the lesson; students must pose a reading question and can achieve 10% bonus points for the exam.
- Peer instruction is used in approx.50% of the lectures [Maz97] (PI)
- Tutorials [McD09]: Student do up to six mechanic tutorials during the exercise classes.

Results and Discussion

1. Measuring Heterogeneity of Beginners



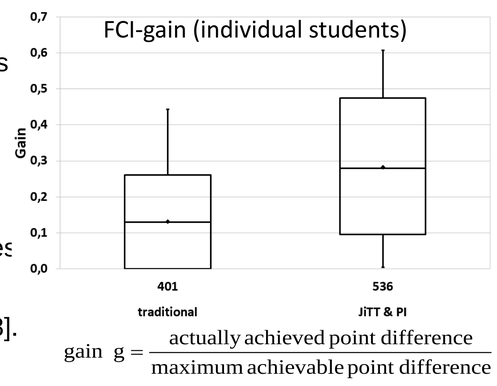
Large heterogeneity of beginners:
First-week FCI-pretest results are shown depending on high school grading (German Gymnasium, Technical Secondary School, Economic and Social Secondary School types) and number of hours of physics per week within the last two school years.

2. Effect of JiTT/ PI - Method

a) on Learning Gain

Significant higher gain is achieved with JiTT/PI-method compared to traditional lecture (data 8 different engineering programs, 2013/14-2016/17, 937 students, 27 courses

Similar results are reported by others [Hak98].

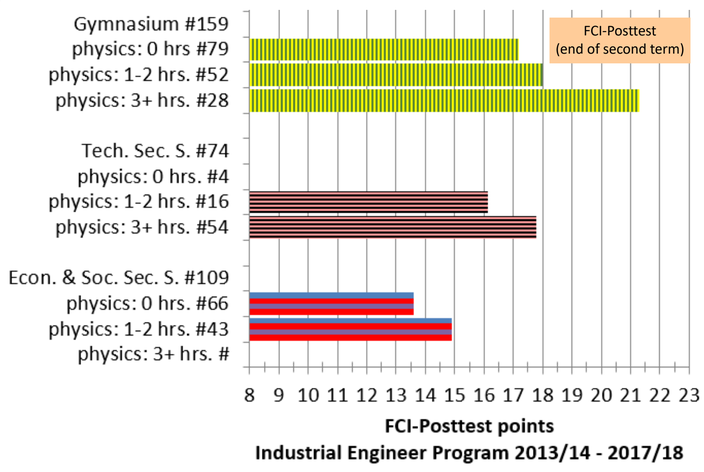


$$\text{gain } g = \frac{\text{actually achieved point difference}}{\text{maximum achievable point difference}}$$

b) on student Learning Behavior

Due to JiTT/ PI-method
- 90 % of students arrive prepared for the lecture (compare before 2013: 50 %)
- 70% of students agree or strongly agree that they make up leeway of technical deficits
- 75 % of students consider it motivating
- 70-80% are very content and content with it

3. Impact of JiTT/ PI – Method on Heterogeneity



- Compare data with figure in 1 - (pretest distribution of exactly the same students)
- On average all student subgroups improve their conceptual understanding.
- BUT the "pattern" remains similar.

➡ The heterogeneity is not dissolved after one year of study!

The most important thing is to learn from the beginning on. It is much more important to understand the topic from scratch and develop a concept. Read the text in the books, read the script, watch videos, **meditate on it and think about it as long as you need**, until everything makes sense and fits together. After that – problem solving is no longer hard to do.

What do you want to tell your successors in autumn 2018 from your experiences?

Written feedback after 1 year of study with active learning methods (Translation from German)

Summary

1. Heterogeneity
- Previous knowledge depends strongly on the type of school grading and the number of hours of physics in the las two school years.

2. Effect
- a) The learning gains with JiTT/ PI/ Tutorials-method are significantly higher than with traditional lecture
- b) Students appreciate active learning methods and spend more time on the subject

3. Heterogeneity
- BUT: Even with active learning methods heterogeneity couldn't be resolved after one year of study!

Outlook
- Adapt thermodynamic concept test
- Spread methods and experiences by workshops to colleagues, also in other fields and other universities
- Share Moodle-questions for JiTT with other universities
- To do so, build a Moodle-server for Moodle-questions

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Poster on AAPT-Conference July 2018 in Washington DC / USA. Details: https://www.aapt.org/Conferences/sm2018/