Digital STACK Tasks and Exam Results

Case study in a large Mathematics for Economists Course

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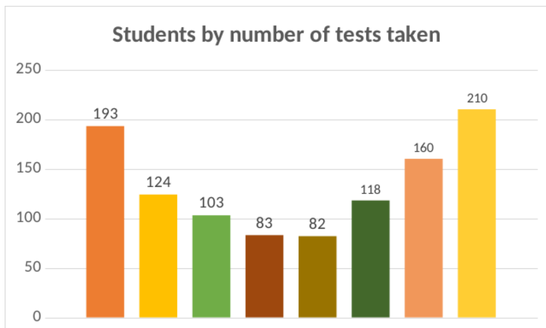
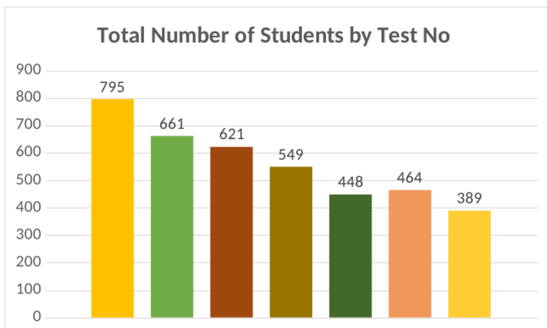
The Course

- Large mandatory first semester course for economics students at Paderborn University (1073 enrolled students, 769 students writing the exam)
- Weekly rhythm: 2 lectures, 1 tutorial (in-class exercises), 1 classroom tutorial (Q&A session), no homework besides online assessments
- Biweekly voluntary online assessments, mainly STACK exercises (80%) and MC questions (20%)



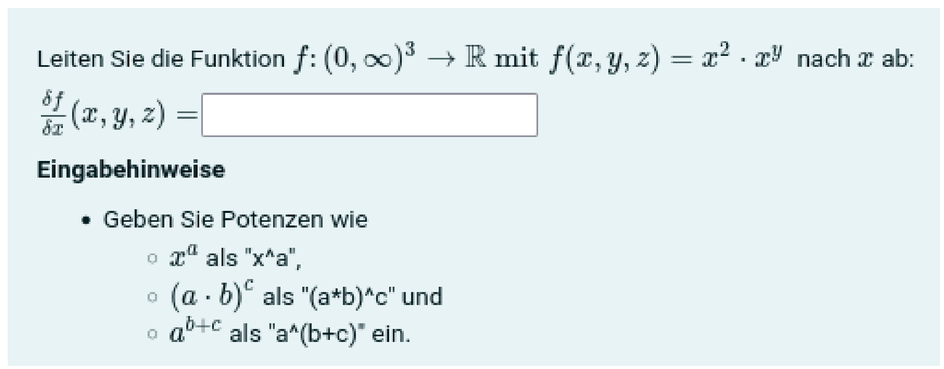


Participation

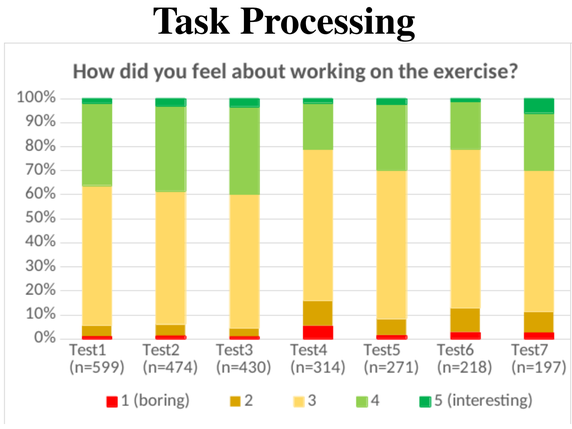
- Initially high participation, but decreasing over the course of the semester
- U-shaped participation pattern: Students tend to either take no test or all tests

STACK Tests

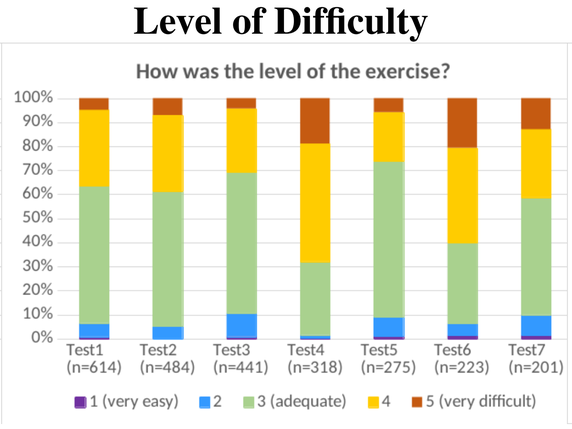
- 8-10 exercises per test
- Fixed duration of 2 weeks
- Mode: Unlimited attempts allowed within scheduled 2 weeks; individual STACK feedback to students' solutions only after submission
- 4 Evaluation questions plus input field for additional comments at the end of each test



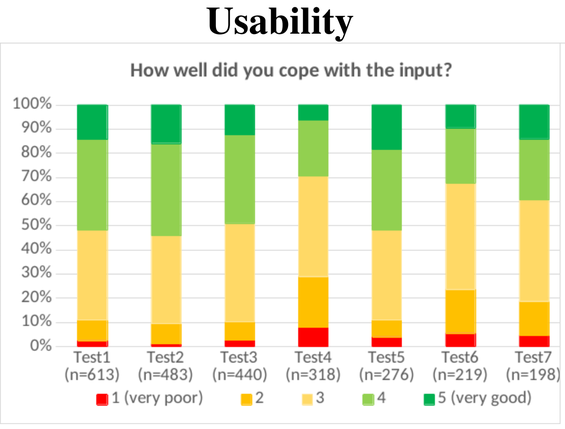
Task Processing



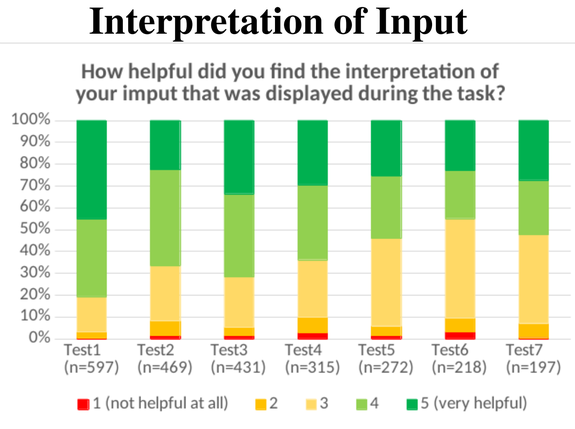
Level of Difficulty



Usability



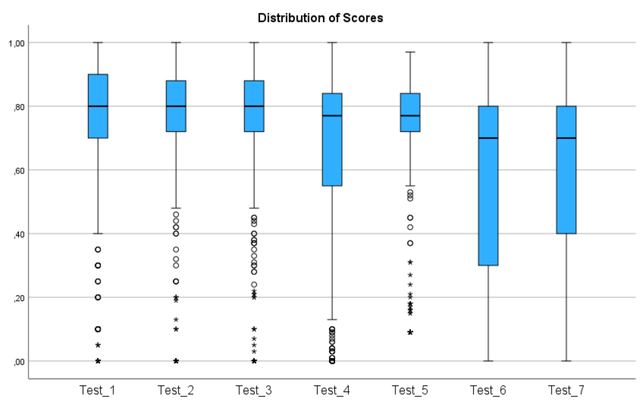
Interpretation of Input



Students' Performance

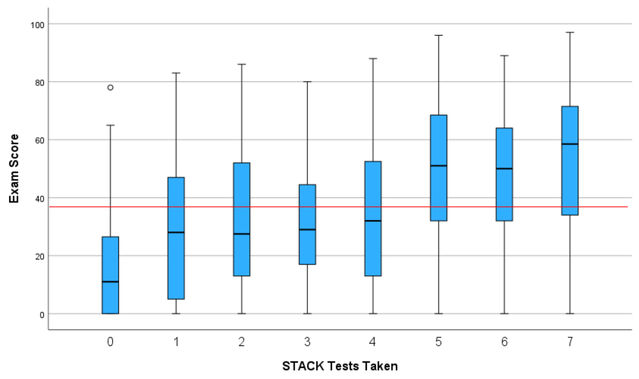
- Anonymous performance data of the students with combined performance in STACK tests and exam score
- Score data for STACK tests is taken as *Points of the best attempt* of each student
- 37/100 points were required to pass the exam
- Number of STACK tests taken positively correlated to exam points received

Distribution of Scores

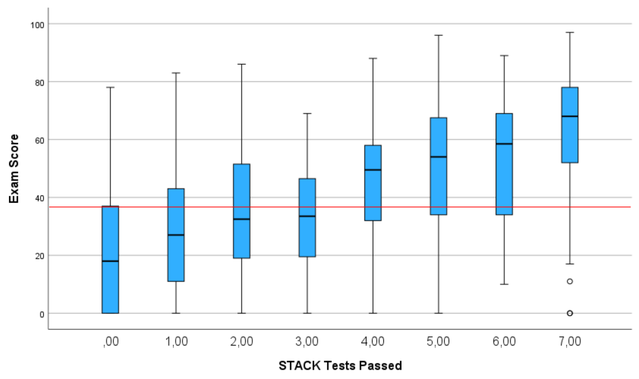


- Incentives: average of Test 1-5 clearly above 70%-threshold, decrease in last 2 Tests Tests 6 and 7: Drop in distribution of scores
- Could be explained by students not trying to reach the 70%-threshold as they had already gained maximum bonus points

Exam Scores



- Significant gap with students not participating at all (0 tests taken vs. ≥ 1 test taken)
- Significantly better performance by students taking ≥ 5 tests, exam points on average far above pass mark (37 points)
- Explains 21% of the variance in the exam grade



- Online tests passed ($\geq$ 70% scored) even better predictor for exam scores
- Explains 28% of the variance

Open Questions

- Is 70% a reasonable pass mark for the STACK tests?
- Do the chosen incentives provide a good motivation to learn new skills?
- Did the students learn mathematics through participating in the STACK tests, or do just good students cope well with STACK tests anyway?
- Which other covariates have a significant influence on the students' performance? What is the relationship between motivation and basic performance?

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