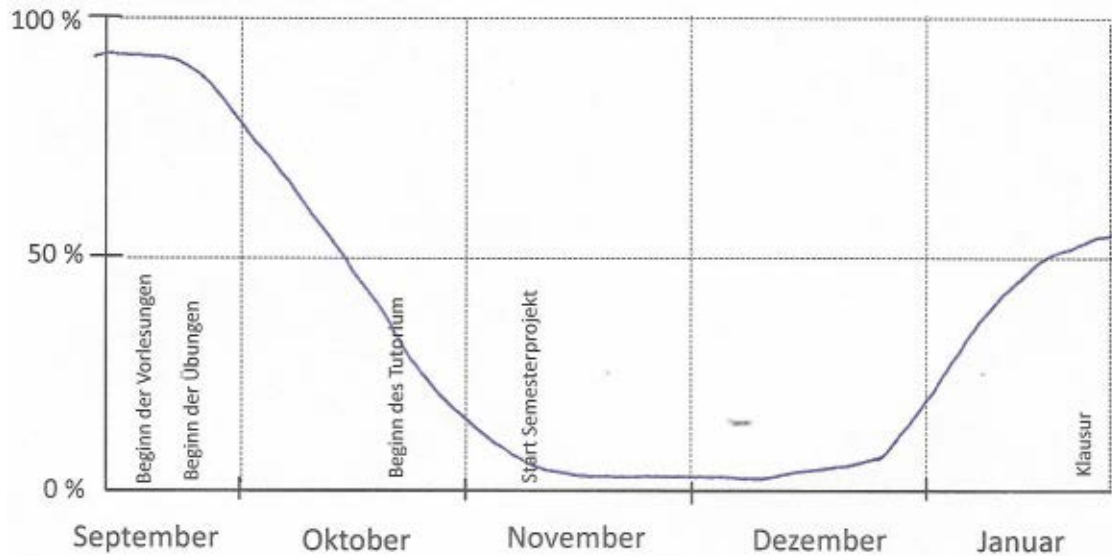# Multi-Level Reward-Based Motivation of Heterogenous Student Groups in Large Undergraduate Courses

Prof. Dr.-Ing. Martin Schafföner 02.07.2018

The Challenge

Example Student Motivation Curve

- 3rd semester mandatory course „Operating Systems / Computer Networks"
- 6 courses concurrently through the semester
- Varying motivation through the course of the semester
- Extremely low homework completion rate
- Large portion of first-attempt exam failures
- Goals:
  - Activation of students throughout semester
  - Lasting learning results for later courses and work life
  - Better exam grades

Heterogenity of Student Participants

- 3 different Bachelor programs
    - Informatik (Computer Science) (all courses in German)
    - Applied Computer Science (selected courses in English + mandatory exchange semester)
    - *Medical Informatics* (application of computer science to medical problems)
- Internal differentiation of CS & ACS via Profiles
    - Cloud and Mobile Computing
    - Intelligent Systems
    - *Digital Media*
- Great differences in knowledge and skills, especially computer programming
- Great differences in intrinsic motivation
    - „I won't need computer networks for my special field of interest."

Multi-Level Reward-Based Motivation of Heterogenous Student Groups in Large Undergraduate Courses
Technische Hochschule Brandenburg · University of Applied Sciences

02.07.2018

3

Course Description

- Basics of Computer Networks
  - Layer Architecture (ISO-OSI, TCP/IP)
  - End-to-End Communication Protocols, e.g. TCP
  - Addressing, Forwarding, NAT, e.g. IPv4
  - Dynamic Routing, e.g. Distance Vector Algorithm
  - Node-to-Node Protocols for Error Control & Flow Control, e.g. Ethernet and WiFi
  - Applications of CN: Concent Distribution Networks, Media Streaming, VoIP, IoT
- Operating Systems Basics
  - Memory Management, e.g. virtual
  - Concurrency and Reentrancy with Threads
  - Filesystems
  - Error Control for Transient and Persistent Storage
  - Aspects of OS: Media Storage, Security Concerns, Performance Problems

Multi-Level Reward-Based Motivation of Heterogenous Student Groups in Large Undergraduate Courses
Technische Hochschule Brandenburg · University of Applied Sciences

02.07.2018
4

Learning Goals

- basic knowledge about OS/CN
- Analysis of network protocols, setup of small-scale computer network, assessment of computer networks through performance measures
- Selection, setup and basic tuning of operating system parts according to performance measures
- Linking of OS/CN with individual field of specialization
- Consolidation of presentation techniques
- Self and peer assessment
- Project work, esp. team work, time management

Some History

- University Teaching Certificate courses between 2014 and 2018
- Experiments with various teaching formats in this specific course Operation Systems/Computer Networks
- Participant in SQB's project „Heterogenity-Oriented Teaching Competences" (https://sqb-hetkom.de/) in winter semester 2016/17

The Method

- Necessary Condition:
    - Mandatory homework completion throughout semester
    - Exam passed
- Sufficient Condition:
    - Teaching video about selected course topic
- Reward:
    - Up to 20% bonus points for grade improvement depending on quality of teaching video

Necessary Condition: Homework Completion

- idea: permanent involvement with the course topic must improve learning results
- condition: acceptable amount of extra work for teacher
- procedure:
  - homework assignments approx. 1 week ahead of lecture hall exercise date
  - 5-7 small to medium sized exercises recapping and advancing the lecture topics
  - students record individual exercise completion with Moodle „(Multiple) Choice" activity before the lecture hall exercise
  - teacher picks students for each exercise according to their votes
  - students explain their solutions on the board
  - if explanation is insufficient:
    - **all current-week exercise votes of failing student rejected**
- Additional advantage: find out about (typical) problems of students when solving exercise problems

Sufficient Condition: Teaching Video

- Motivation:
  - Should get digital media affine students involved
  - Does not discriminate other "non-programmer" students
  - It's fun… (but a lot of work)
- Procedure:
  - 1st week: project dating through Moodle "(Multiple) Choice" activity
  - 3rd week: topic selection from pool, handout of teaching video guidelines
  - 6th week: hand-in of script, brief feedback
  - 11th week: final hand-in of video
  - 13th week: grading, distribution of (good) videos to larger course

Multi-Level Reward-Based Motivation of Heterogenous Student Groups in Large Undergraduate Courses
Technische Hochschule Brandenburg · University of Applied Sciences
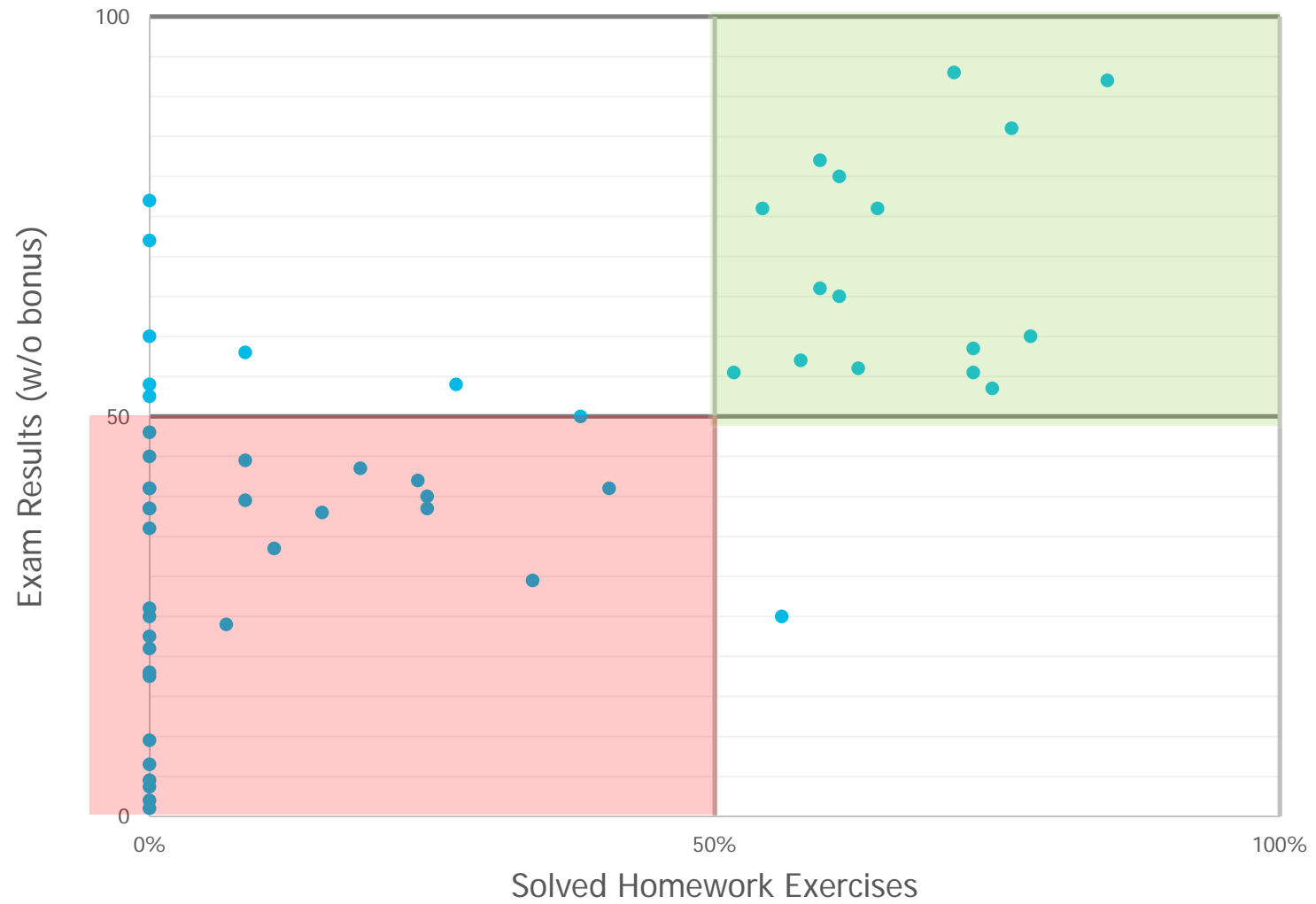
02.07.2018
9

The Reward: Exam Bonus

- grading criteria
    - 15 points for correctness and precision of technical topic
    - 5 points for video quality, presentation technique, length restrictions
- Reward conditions
    - Written exam passed
    - At least 50% of homework exercises solved
- At best, +1,3 grade points improvement of exam grade

Multi-Level Reward-Based Motivation of Heterogenous Student Groups in Large Undergraduate Courses
Technische Hochschule Brandenburg · University of Applied Sciences

02.07.2018
10

Results

Student Challenges

- Work load
    - Never exceeding projected workload of ~8hrs/week for 5 ECTS course (avg. 4.5hrs/week)
    - Video creation about 8-12hrs total
- Correctness and precision, terminology
- Creativity
    - Presentation order and focus points almost identical to lecture presentation

Multi-Level Reward-Based Motivation of Heterogenous Student Groups in Large Undergraduate Courses
Technische Hochschule Brandenburg · University of Applied Sciences

02.07.2018

12

Further Improvements

- Move exam up in schedule
- Change course plan from 3hrs lecture with exercises + 1hr lab -> 2hrs lecture + 2hrs lab
- Extend support for term project
  - Use student teachers also for project plan review and support

- Mid-project peer review feedback
  - Less work for teacher, more learning for students

- Make effect of sustained exercise work on exam result transparent in first lecture

- Transparent feedback of current exercise solution balance through Moodle
  - Probably needs new activity with automatic self-grading (exercise votes) and manual teacher overrides

Instructor Challenges/Improvements

- Summarization of multiple weeks' student votes not supported by Moodle

  - Excel sheet to summarize results, color-code students with missing blackboard review

- Video grading very time consuming

  - Written exam: quickly scan over result, find correct pieces, grant points

  - Video: only possible in real time, frequent rewinds, grading/feedback needs separate text file with timestamp references

    - Video grading/annotation tool needed

Some Video Samples

Summary

- qualification points from semester-long homework exercise solutions with sampled checking and whole-week deductions in case of insufficient work
- Exam bonus from optional teaching video production, only for grade improvement after passing
- 95% of students with at least 50% homework solutions passed the exam, 75% of students with less than 50% homework solutions did not pass the exam
- Re-use of finished videos as teaching material, improved presentation and teamwork skills

Thanks for your Questions!