Motivational Active Learning for Computer Science Education

Johanna Pirker, Christian Gütl
Institute for Information Systems and Computer Media - Graz University of Technology

Abstract

Motivational Active Learning (MAL) is an innovative pedagogical approach based on MIT’s teaching format TEAL (Technology-Enabled Active Learning) combined with advanced motivational strategies based on gamification design aspects. The main idea of MAL is to enhance learning outcomes using motivational and social learning experiences. The lecture format is designed for courses, which combine theory in computer science with hands-on programming challenges and collaborative in-course problem solving. The main features of MAL include collaborative learning, constant interactions to stimulate interactions between instructor and students, immediate feedback for self-assessment, and motivational feedback such as badges or leaderboard information. The course is structured in the form of mini lectures with constant interactions and challenging interactions such as small arithmetic problems, programming challenges, or research and discussion assignments, which are available using a learning management system as supportive in-course technology to provide the interactive course content and according immediate feedback. First outcomes show positive impact on student motivation and attention during the lessons. Also, more students are willing to complete bonus tasks voluntarily to gain extra points.

Introduction and Background

- Active Learning formats successfully raise the conceptual understanding [1,2,3]
- Cooperative learning strategies deliver the best learning outcomes (compared to competitive and individual) [4] and enhance student engagement [5]
- Motivation is one of the most important driver for successful learning [7]
- Gamified classroom scenarios can enforce intrinsic motivators [6,7]

Objectives

- Design a course combining (1) theoretical background and concepts, (2) algorithmic understanding, and (3) analytical understanding of mathematical models
- Engaging students by interactive and motivational activities
- Increase the students’ motivation with hands-on exercises and collaborative tasks

Course Design

- Collaborative Learning: Students solve tasks in small subgroups of 2 or 4.
- Constant interactions: Concept questions, small quizzes, and discussion questions are used to stimulate the interactions between instructor and students.
- Immediate feedback: The majority of the tasks and quizzes deliver immediate feedback.
- Motivational feedback: Badges for special activities and leaderboard information deliver motivational feedback.
- Errors are allowed: Students are able to revise assignments and repeat quizzes.
- Positive reinforcement: Additional effort should be rewarded and students should not be punished for failing single exercises.
- Adaptive class design: Measuring the learning progress during and after class allows in-time adaption the individual learning speed of the class.

Motivational Active Learning in Action

Lecture 3

Example class structure

Motivational Active Learning in Action

Overview of the different course elements

Results and Observations

The approach was evaluated in a first test series with a class of 28 students (course: Information Search and Retrieval).

Future Work

- Course 2015 : Change group size to 3 students
- Advanced balancing of instructions and assignments
- Smaller but more calculations and programming examples
- Advanced automated assessment and integration into Moodle

Acknowledgements

This work is a work in progress. An extended version is submitted at ITICSE 2014. At this point we want to thank our students at Graz University of Technology who have participated in this study and the team of CECI at MIT who inspired us with their active teaching format TEAL.

Selected References


Contact Information

Web: www.iicm.edu
Email: jpirker@iicm.edu
Email: cguetl@iicm.edu