

Improving Activity and Motivation of Students with Innovative Teaching and Learning Technologies

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Abstract

In this paper, we present new technologies that can be used in lectures to increase the activity and motivation of students. The poor communication between students and teacher is one of the major problems in mass lectures. However, mobile devices can reduce this problem and by improving the interactive communication help to increase the motivation of the students. We have implemented a set of interactive services, which have been tested and evaluated in several lectures and courses of our computer science and psychology department. In particular, we present a participatory simulation in form of a stock exchange. Users taking part in the computer-based simulation become private investors who are able to buy and sell securities. Participating in the simulation facilitates the understanding of the complex system of a market and increases the activities of the students.

Keywords: participatory simulation, interactive learning, new learning technologies

1 Introduction

In mass lectures or tele-lectures the motivation of many students is very low. The distance between teacher and student is too high to allow for proper bi-directional communication, thus rendering the student almost completely passive during the lecture. Also it is almost impossible for the teacher to recognize if the content of the curriculum was understood well. Mobile devices (e.g., PDA's or notebooks) provide different services aiming at the improvement of interactivity and creating additional, computer-moderated channels of communication between the students and the teacher. Quite a few projects focusing on using

mobile devices in lectures in order to enhance learning and teaching have evolved over the last few years like *ClassTalk* [4], *ConcertStudeo* [3] or the Classroom Feedback System [1].

A different approach to improve the learning success and the motivation of pupils or students is based on *participatory simulations*. A participatory simulation is a role-playing activity that helps to explain the coherence of complex dynamic systems. Global patterns emerge in participatory simulations from local interactions of users. A major idea of participatory simulations is the concept of *learning through doing*. Students participate in an active way, analyze information, make decisions and see the outcome of their actions. This increases the motivation and the learning success improves [5]. Simulations were realized with paper and pencil in the past, but the technological advances made a complete new type of simulation possible. Hardware devices were developed to support participatory simulations like the *System Blocks* [10] or *Thinking Tags* [2]. *NetLogo* [8] is a software-based environment for the development of participatory simulations. The *HubNet* extension [9] supports the participation of several human players in a simulation.

2 Interactive Learning Technologies

This section gives an overview of two systems, which use devices to increase the interactivity and motivation of students in lectures. The WIL/MA technology (*Wireless Interactive Learning at the University of Mannheim*) provides services for interactive lectures. The NetLogo/HubNet system is especially designed to develop and run participatory simulations.

2.1 Services in Interactive Lectures

The WIL/MA architecture [6, 7] basically consists of three components: a server and clients for the lecturer and the students. The main task of the *server* is the communication between the clients and the teacher, and the aggregation and analysis of incoming data. The *teacher* configures the services and starts the sessions; the *student clients* are the actual user front-ends. Figure 1 shows a possible setup of the WIL/MA system. The student clients run on desktop PCs or laptops as well as on PDAs with a Java Virtual Machine. It is possible to use all device types simultaneously in the same session. Currently, services have been implemented that allow students to give feedback, ask questions or give comments about the lecture. E.g., the teacher can interrupt the lecture and verify the learning success with a quiz service: Questions are transferred to the mobile devices and the students send their answers back to server. If the teacher recognizes problems in the aggregated results, he can repeat specific topics.

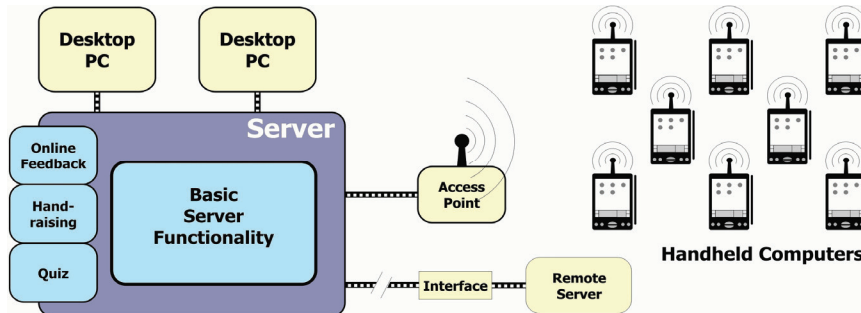


Figure 1: Overview of the WIL/MA system

2.2 Participatory Simulation with NetLogo/HubNet

We used NetLogo jointly with HubNet to implement a participatory simulation of a stock exchange. Students have the possibility to take over the role of a private investor and trade stocks. Figure 2 depicts the interface of the students and visualizes information about the asset of a user and stock prices. Randomly selected students receive automatically generated information about future price trends, which can be interpreted as insider information. The teacher takes on the role of the administrator and activates, interrupts or stops the simulation. In addition, he has the possibility to send messages to participants and give individuals or groups of investors information about future price trends. Artificial investors act according to proven economic principles and differentiate their investment strategies with respect to available information and risk preferences. All participants are ranked in a high score list according to their total assets after the completion of the simulation.

3 Evaluation and Results

The WIL/MA technology, which is available under the Open Source license, was developed to support interactive lectures with mobile devices. Different services like hand-raising, feedback or a quiz tool are available (see Figure 3). Many improvements and extensions like clickable images or the support of animations were added in the last years. Thorough psychological evaluations in these so-called Interactive Lectures indicate that the usage of mobile devices increases the motivation and activity of students. The mobile devices were used and evaluated in six courses with up to 240 students in each lecture until now (Scheele2003, Scheele2004). The activity and motivation was analyzed and a significant increase of the learning success could be observed.

In the context of participatory simulations, we analyzed the motivation of the students and the technical applicability of the NetLogo/HubNet system. An example of the NetLogo client is depicted in Figure 2. We analyzed the

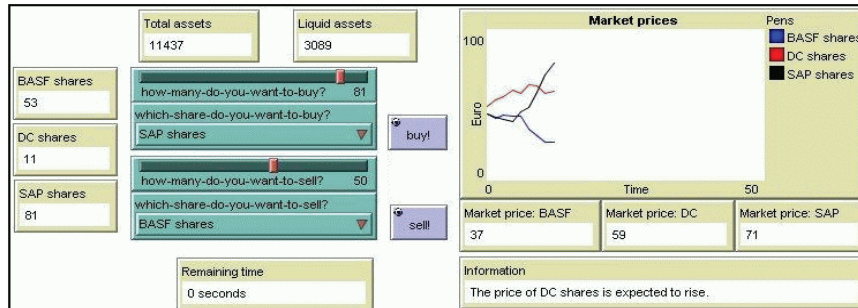


Figure 2: NetLogo client of a stock exchange

behaviour and the decisions of the artificial agents in 139 simulations. As expected, the standard deviation and the average total asset at the end of the simulation are higher for the agents that take higher risks. Artificial agents that receive (and use) insider information could increase their asset significantly. During the experiments, the motivation of the students was very high. The economic competition is a major factor for the motivation.

One of the major strengths of NetLogo is the interface builder. Elements of the client window can be arranged by *drag and drop* and it is very simple to add code to the elements. A graphical visualization for histograms or plots is available and the network support for the clients works quiet well. A major disadvantage of the interface is its low flexibility. It is not possible, e.g. to visualize tables, use more than one window or change/rearrange the items in the window during the simulation. The input on the clients is limited to sliders, choices or buttons. The internal use of lists and the missing exception handling is bothersome: The program crashes, e.g., if the teacher enters a character but the program expects a number. On the other hand, the effort to create a new simulation is very low. NetLogo is particularly useful if the number of parameters and interactions is not too large.

4 Outlook

The NetLogo/HubNet and the WIL/MA environment are mature systems that are suitable to support teachers in interactive lectures. The architecture of WIL/MA has proven to be very flexible and many services to support new learning technologies have already been integrated into this system. A major advantage of participatory simulations is the fact that students learn to see patterns and understand coherences much easier. With all the technical advances it is of particular relevance to keep in mind that only a part of the learning can be done with participatory simulations. The communication and discussion is always an essential part of the learning process. We believe that the emerging field of mobile interactive services and participatory simulations improves – especially in the case of complex problems – the learning success of students.

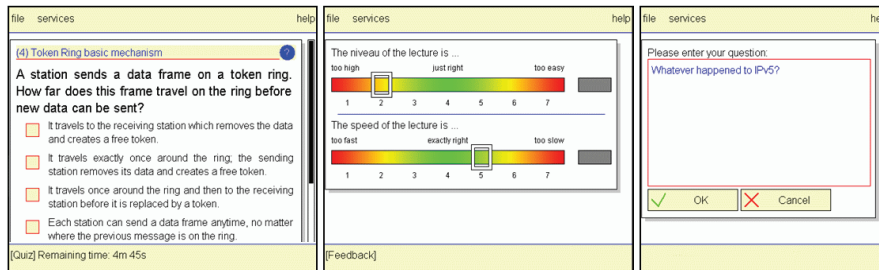


Figure 3: Screenshot of the students' client showing a quiz, feedback and call-in

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