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# USING MOBILE DEVICES TO INTEGRATE ECONOMIC SIMULATIONS IN TEACHING APPROACHES BASED ON DIRECT INSTRUCTION

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## ABSTRACT

The increasing proliferation of mobile devices brings with it opportunities for developing innovative didactic scenarios for university lectures. This potential for development is particularly evident in lectures with directive teaching methods, in which participants assume a passive and receptive role and the lecturer receives no feedback on the learning progress of the students. In lectures without accompanying tutorials, this problem is even more prominent, as the knowledge transmitted can neither be applied nor tested in other contexts. In order to address this issue, a technical system and a concept for integrating interactive exercises into lectures is being developed as part of the MTED project. An interventional study (n=331) will investigate the effect of interactive exercises in economics lectures on students' learning processes.

## INTRODUCTION

Current forecasts show that there will be a strong growth in the use of mobile devices over the next few years (Llamas et al., 2013). This development can be used to more actively include the participants in the learning process with the integration of mobile devices, and to investigate the effects of this on the transfer of knowledge. In this context, lectures without accompanying tutorials constitute a subject for research, as (1) the participants can neither apply nor transfer the knowledge learned during the lecture, and (2) the lecturer receives no feedback on the learning progress of the students. Furthermore, current findings in modern didactics, which are rarely considered during the planning phase when using directive teaching methods, indicate that such an intervention is necessary. "Progressive educational concepts as well as cognitivist and constructivist theories of learning consider learning as an independent activity, and see the learner (subject) in a manner that is very similar to the (neo-liberal) concept of a (self-) responsible and self-managing subject (Rabenstein/Reh, 2007)". Based on this concept, studies from scholastic environments show that directive teaching methods (cf. table 1) are more effective in transmitting knowledge, and therefore superior to other methods. This conclusion was made based on studies (Hattie 2009) that show that frontal instruction is more effective, efficient and time-saving than other teaching methods when learning cognitive competencies and when applying knowledge (cf. Ofenbach, 2003: p. 307-315). On the other hand, non-directive teaching methods may be beneficial when non-cognitive goals, such as social learning, cooperative abilities, creativity, imagination and self-confidence are to be integrated into the curriculum. This was the conclusion Paetzold (cf. Klusmeyer et al., 2003) arrived at after evaluating a study involving 1400 school students and 177 teaching staff, and discovering that two-thirds of the students felt that frontal teaching negatively affects motivation. The studies carried out by a research group (Nickolaus et al., 2003) could not find any clear evidence to support the assertion that a directive and guiding

approach is inferior for industrial and technical vocational training courses. These studies allow requirements to be inferred for planning school curricula. However, university lectures typically take the form of directive teaching methods, and in particular from an economic point of view, the utilization of alternative teaching methods appears to be difficult to implement. On the other hand, a study (Deslauriers/Wiemann, 2011) showed that the use of various methods (discussions, clicker systems) can increase the knowledge gained, as well as improve motivation and the transmission of theoretical concepts. In the context of economics lectures positive effects through the use of economic experiments and simulations could be determined (Schloesser et al., 2012). Compared to the study of Wiemann, this study also shows that classroom experiments can improve the transmission of theoretical concepts (see e.g., Holt and Davis 1993, Holt 2006). In relation to these research results, the question arises, which effect have economics simulations on knowledge acquisition and other non-cognitive skills of students in university lectures.

table 1: Teaching approaches based on direct instruction are advantageous for: (cf. Klusmeyer et al., 2003)					
	is always correct	is often the case	applies rarely	does not apply	not specified
Be able to cope the contents of the curriculum.	50.6 %	40.3 %	3.4 %	3.4 %	2.3 %
Acquire knowledge about concepts.	28.4 %	61.4 %	8.5 %	0.6 %	1.1 %
Elaborate contextual knowledge.	15.3 %	52.8 %	23.3 %	4.5 %	4.0 %
To learn how to apply knowledge.	3.4 %	24.4 %	43.8 %	26.1 %	2.3 %
Increasing the independence of the students.	1.7 %	5.7 %	44.3 %	46.0 %	2.3 %
Promoting the problemsolving skills of the students.	1.1 %	24.4 %	42.6 %	29.0 %	2.8 %
Promoting a practical school education.	3.4 %	20.5 %	41.5 %	31.3 %	3.4 %

## MTED PROJECT

The project MTED ([www.mted.de](http://www.mted.de)) provides a “rapid application development tool” for the design of interactive lectures. The implementation of learning applications carried out via MTED modules (general and domain specific) that contain technical contents and pedagogical structures. The following interactive task “option trading” shows the exemplary construction of a collaborative MTED module. It has already been used and evaluated in the context of a finance lecture. From specialized scientific point of view options are a financial derivative that represents a contract sold an option writer to an option holder. The option contract offers the buyer the right, but not the obligation, to call or put a financial asset at an agreed-upon price (strike price) during the exercise date. The participants have the possibility of trading options on a stock exchange in the lecture by using their mobile devices. Figure 1 shows the participants view, in which the parameters number of shares, share price, bounty and execution date can be adjusted to place options on the virtual stock exchange. Besides the sale of options, the participants can purchase the options placed on the stock market, which were placed by the other participants of the lecture. As additional information the current market price, the current date, the rate forecast and the current transactions of the participants are displayed with the beamer. The transactions on the stock exchange are analyzed by the simulation model and displayed on mobile devices. After completion of the simulation, the lecturer can access individual strategies of option transactions and connect to terms such as strike price, in the money, at the money or out of the money.

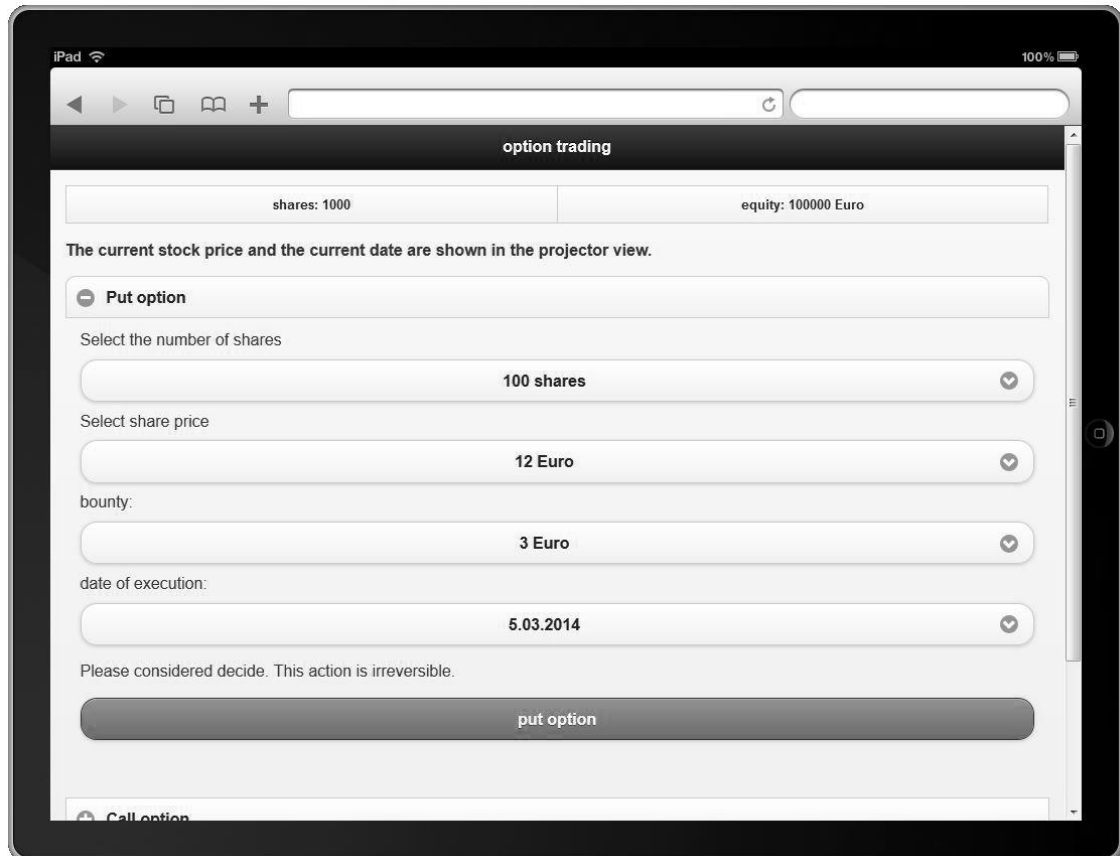


figure 1: participants view

## DESIGN OF THE RESEARCH

During the winter term 2013/12 an intervention study to analyze the effect of MTED modules on knowledge acquisition of students in university lectures was conducted. Overall, two variants were developed for the individual lectures. In the first variant (interventional group), interactive exercises were integrated into the lecture via mobile devices. For example, in the lecture "Economics I", the following modules were included:

- **Module A1: Leverage effect**  
The participants determine over several periods the amount of the debt financing in conjunction with a case description and experience the effects on equity, equity ratio, return on equity, return on assets and other financial indicators.
- **Modul A2: Trading with options**  
Participants take part in a simulation and can place and purchase options on a market in real time. With the projector current market events will be displayed.
- **Modul A3: Criticism of the leverage effect**  
The participants have previously tested the leverage effect in the module A1. Afterwards each participant has to prefer one point of criticism. At the end, the module provides a rated list of criticisms of the leverage effect (Aulinger et al., 2009).

- Modul A4: new shares and corporate bonds

In the context of a case description, the participants learn about the relative financial costs of an issue of new shares compared to the issue of corporate bonds.

In the second variant (control group), the lecture was carried out without interventions, such that only the implementation of the interactive exercises was varied. At the current time, the MTED modules are being tested in two lectures on the topics of investment, financing and accounting with a total of 331 students. In order to collect information on various constructs, the use of the MTED modules was evaluated with the use of standardized survey forms. In the first section of the lecture, a pre-test was carried out, where data on motivation, prior knowledge, self-evaluation, acceptance of mobile devices, concentration and learning preferences was collected. In the subsequent three lectures, two interactive exercises including a feedback phase were carried out in each case, after which they were evaluated with the use of a survey form at the end of the lecture. By doing so, a comprehensive amount of data could be collected for the analysis of cognitive and non-cognitive effects. At the end of the semester, a test of the students' knowledge will be carried out via the final exam. The data collected is expected to allow possible effects arising from the use of interactive exercises to be identified at the end of the comparative semester.

## RESULTS

What follows below is a presentation of the initial results for the module "trading with options", as the overall data collection has not yet been completed. This module was covered in the lecture "Economics I". There were 43 male and 54 female students who participated (n = 97). The majority of the participants was between 21 and 23 years of age and in their third to fourth semester. In addition, the pre-test showed that most of the participants preferred textual explanations to mathematical ones when attempting to acquire the knowledge in the lecture.

	fully agree	somewhat agree	rather disagree	do not agree at all
mathematical formulas (for example: calculation of interest)	4.1 %	23.7 %	42.3 %	29.9 %
technical texts and application examples	32 %	62.9 %	3.1 %	1.0 %
graphics and images (for example, a curve for the cost comparison method)	23.7 %	49.5 %	19.6 %	5.2 %

Based on these basic parameters, the participants' prior knowledge of the topics covered in the lecture was also assessed in the pre-test. Most of the participants felt that they had very little prior knowledge of business studies (> 90 %). At the same time as the pre-test, a specialized test was also carried out to ascertain the level of prior knowledge students had on the following topics: Basic Terms (G), Investment Basics (IG), Investment Methods (IM), Financing Basics (FG) and Financing Methods (FM).

G	IG	FG	IM	FM
37.29 %	35.82 %	23.34 %	35.88 %	4.04 %

Table 3 shows that, contrary to their self-assessment, the participants did have some prior knowledge of the topics of the lecture. This is probably due to the fact that some of these topics were covered in foundation lectures that these students attended earlier on. However, the poor

performance in "Financing Methods" was striking. Due to this, the decision was made to include the module "trading with options" in the lecture. In addition to information on prior knowledge, it was also necessary to collect information on the extent to which the participants were willing to accept the use of mobile devices. From the results of the pre-test, it was possible to ascertain that most of the participants were willing to do test exercises on their mobile devices during the lecture. At the same time, the uncertainty among the participants, who had no specific information on the use of the interactive exercises at the beginning, was also apparent from the acceptance survey. The surveys conducted at the end of the interventions showed that the acceptance of the use of mobile devices to facilitate the integration of exercises increased with the amount of information participants received on the process. In addition to these basic parameters, the extent of the influence of the interactive exercises on the concentration and motivation of the participants was also examined. Most of the participants indicated that their concentration declined during the course of the lecture. Similarly, further surveys showed that neither the topic nor the lecturer had a significant influence on the participants' motivation.

	fully agree	somewhat agree	rather disagree	do not agree at all	not specified
The subject of the lecture motivates me to an engagement with the contents.	2.1 %	24.7 %	56.7 %	15.5 %	1 %
The lecturer of the course motivated me to an intensive engagement with the contents.	4.1 %	27.8 %	57.7 %	10.3 %	0.1 %

Based on the results of the pre-test, effects could be identified using the data from the module "trading with options". An evaluation of the trading strategies showed that 39 participants were able to increase the initial value of their \$100.000 portfolio with the use of stock options, while 14 incurred losses from exercising their stock options. In total, the participants placed 242 options on the market, of which 160 were acquired and 120 were accepted on the execution date. Table 5 shows which options were placed on the individual trading dates on average:

execution date	1	2	3	4	5	6	7	8	9	10
number	320.37	181.25	200	173.33	177.77	292.30	189.47	233.33	193	189.65
price	20.37	17.75	15.53	22.4	21.11	25.46	30.15	24.56	27.47	27.10
bounty	4.42	3.125	2.26	5.26	5.11	6.15	6.15	7.63	9.03	10.03
current share price	18	15	19	20	32	21	45	45	12	19

Although many options were placed on the first trading date, the participants probably realized that this strategy was not very productive, and over time the number of stocks per option was reduced. During the transition from day 5 to day 6, the influence of the positive forecast of the stock prices for day 5 became apparent, resulting in more options being placed on the market. Furthermore, the results showed that the participants based the placements of their options on current share prices and the forecast for the stock market price. At the same time, the error rate when placing options and the valuation of the options on the trading date also decreased. This behavior allows one to conclude that the participants had understood what a "strike price" is and were able to estimate it correctly on the trading date. In conclusion, an analysis of the data

suggests that most of the participants were able to "logically" set the parameters "shares", "share price", "bounty" and "date of execution" by taking into account the current market situation, and that they had acquired an understanding of these basic concepts. Moreover, the participants also reported that in addition to their motivation, their interest in the topic of financial derivatives had also increased. The impact on concentration is not clearly evident (cf. figure 2). The module "trading with options" was conducted in the second third of the course. This visualization shows that the concentration is considerably affected by the intervention. On the one hand, the concentration is improved in the second third of the lecture, on the other hand, there is a distinct redistribution of the concentration.

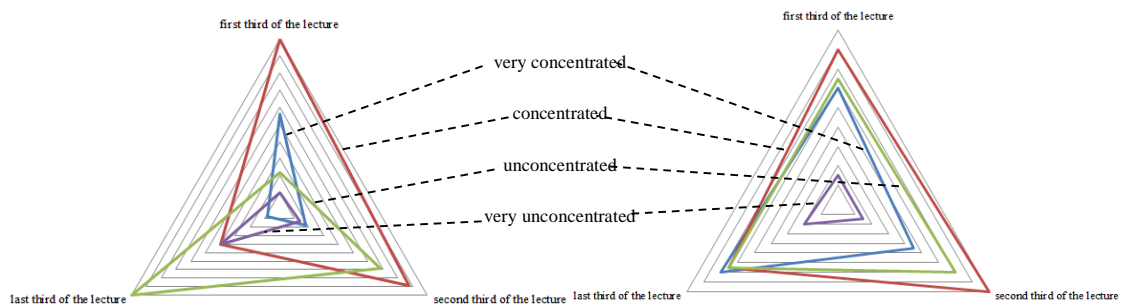


figure 2: Comparison of the concentration from the pre-test (left) with the concentration in the lecture, in which the module "trading with options" was tested (right)

## PROSPECT

With the MTED project a pedagogic and technical overall concept to present interactive simulations in lectures was developed. Altogether twelve interactive exercises could be implemented and evaluated in six lecture units. Through the first analyzes of the data collected positive effects of this interactive exercises can be identified. The results of the simulation "trading with options" show that technical terms of a lecture can be applied directly by the students. In addition, the application has a positive impact on the motivation and concentration. Final results with regards to knowledge acquisition, cognitive and non-cognitive skills will be available after evaluation of the control group in February 2015.

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