Project Report LectureLab

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It is eight o’clock, Monday morning. The class starts in 15 minutes. 500 students and one professor who is supposed to teach them mathematics. This is a challenge, as there are 500 individuals and one cannot read their thoughts. Some of the students are finishing their coffee, many are yawning, rubbing their heads and quietly suffering under the prospect of differential equations.

It’s hard to follow complicated algebra, sitting in a huge lecture hall surrounded by an anonymous crowd of fellow students, watching a tiny person in front of a large blackboard scribbling down random numbers or flipping through some complicated looking slides. It is very tempting to put off concentration for two more minutes and have a look at your favorite social network – just to see what happened on the weekend – to write messages and dwell in the smartphone distraction just a little longer. It would be difficult to give a talk about any topic in front of such a huge indifferent mass of people. How would you feel expressing that a cure for cancer has finally been found, but everyone is more interested in their coffee? Is there a way to enhance conveying the fascination of mathematics to 500 students who are getting more and more confused and tired with every slide, filled to the last corner with complicated formulas? In this technologically advanced world we live in, where communication around the globe is easier than ever before, how would you feel expressing exactly what I was wondering for a while, but I couldn’t really put into a proper question. Sometimes we even surprise the lecturer and come up with a question he had never thought of. In these cases, he seems really excited about how well the tool works and encourages us to continue asking. I have the feeling that it also eases his work a little. He gets feedback on what topics are actually challenging for us – just by looking at the number of questions raised – and it seems to lower the number of students that come to him after the lecture with questions they didn’t want to, or were afraid, to ask during the lecture. It seems like a win-win situation and my learning experience has definitely improved.

Normally I used to go out of the lecture hall some minutes before the lecture ends to get a coffee before catching the bus, but now every minute of the lecture is more valuable than a coffee, so I stay till the end and so do the others. Impressed by the new possibilities we leave the lecture hall.
Abstract
LectureLab proposes an e-learning tool that improves profes- sor-student communication during lectures, something which has been deteriorating in recent years as student numbers have increased rapidly.

A number of e-learning tools have been analyzed in detail and categorized with respect to both technical and didactical featu- res. Moreover, three lectures were examined by applying different e-learning tools and surveying students’ and lecturers’ perspec- tives before, during and after using the tools. The surveys were qualitatively analyzed and highlighted both positive and negative aspects of the tools, such as an enhanced interaction between the lecturer and the students, but also potential disappointment if the interaction did not lead to the desired changes and enhancements. Other critical points such as the potential of the tools to distract students appear to be less important, according to the survey re- sults. All in all, e-learning tools seem to be a promising add-on in lectures where interaction between the lecturer and the students is not possible on a personal level.

1. Introduction
In recent years many countries have begun to see the need to advance towards a knowledge society and thus political directions have fostered access to third level education in their education systems. This has resulted in rising student numbers especially at university level. This in turn has led to lectures with large class sizes and a more complex learning environment with less commu- nication between lecturer and student (Milliken & Barnes, 2002). Moreover, the rapid development of information and communicati- on technology and the concurrent emergence of so called “digital natives” entering universities has posed a new challenge to hig- her education, “where educators will no longer serve mainly as the distributors of content, but will become more involved as facili- tors of learning and assessors of competency” (207).

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2. Goals and methods
The goal of this project was to analyze the impact of e-learning tools on the student-lecturer interaction in the context of a pilot project at TUM. The goal is to make a contribution to an improved student-lecturer interaction during lectures. The following sections present the methodology used to achieve this goal.

2.1 Study design
The present pilot project is an intervention study following a pre- test-post-test design. As is characteristic for intervention studies, test data was then collected with a similar questionnaire in the last lecture of the semester, after the last possible intervention of the project team. The present pilot project is an intervention study following a pre- test-post-test design. As is characteristic for intervention studies, test data was then collected with a similar questionnaire in the last lecture of the semester, after the last possible intervention of the project team.

2.2 Sample and pilot study procedure
As preparation for the intervention study we carried out extensive literature research as a first step in order to assemble a pool of e-learning tools. Besides user-friendliness and functionality, the tools had to be for free and unlimited in terms of the number of users. We classified the suitable tools into three different categories: “tools that younger students barometer” and “question inputs”. In addition to the literature research we interviewed seven lecturers from TUM, who are already using e-learning tools in their lectures. Additionally we interviewed two didactic and teaching experts from the ProLehre institute at TUM. The aim of ProLehre is to improve teaching quality at TUM. On the whole, we had eight qualitative interviews in order to prepare the pilot study procedure.

In the expert interview with ProLehre we advised them to include only younger students in the pilot project. This derived from the as- sumption that younger students have been less strongly influenced by the atmosphere in lectures and therefore should be less biased about lecture input. Consequently we decided to include only few first-semester stu- dents in the summer term we decided to focus on second-semes- ter students. With the help of the university calendar we created a list of lectures in summer term for second-semester students. We selected three lecturers from different disciplines and invited them to participate in our pilot project. Fortunately, Dr. Tobias Laslier (Chair for Computer Aided Medical Procedures & Augmented Re- ality), Dr. Christian Karpfinger (Research group Algebra) and Prof. Dr. Gerhard Müller (Chair for Structural Mechanics) agreed to par- ticipate in the pilot project.

Before the actual start of the summer term we talked with each of the three lecturers about their experience with e-learning tools. As an agreement was reached, the first lecture served to introduce them to the study, while in the second a suitable e-learning tool was chosen. Additionally, we organized one meeting during the semester to exchange information and advice on how to use them. Post-test data was collected with the help of a questionnaire. The questionnaire was similar to one used in a previous study. The post-test data was collected with the help of a questionnaire. The questionnaire was similar to one used in a previous study. The post-test data was collected with the help of a questionnaire. The questionnaire was similar to one used in a previous study. The questionnaire was similar to one used in a previous study.

2.3 Analysis
The questionnaires were presented with the evaluation software Evatys. Therefore, the questionnaires could be scanned and evaluated automatically. Beside the economy of time, the risk of input errors in the database is reduced by using this software. Results from the qualitative interviews with the three lecturers from the pilot projects were used to create the individual profiles of e-learning tools from different sectors. Suitable quotations were chosen for these profiles, which will be communicated online by the ProLehre institute.

3. Results
Since not all of the collected data is relevant for the analysis, not all parts will be presented. No distinctions are made between the three different courses forming the pilot project. Instead all student sets are combined in order to obtain the largest sample size possi- ble, which is not the impact of peculiarities of the single lectures.
This results in 909 entered questionnaires for the pre-evaluation and 552 for the evaluation at the end of the semester. This remarkable decrease is mainly due to the falling attendance over the duration of the course.

Although there have been several technical issues with the e-learning tools in use, the majority of the students reported that they seldom experienced these. Fifteen percent of the participants even stated that they have never encountered any problem (Figure 3).

However, the gender distribution remained constant with 78% men and 22% women in both surveys (Figure 2).

The participation of the students in the usage of the tools is quite symmetrically distributed between the two extremes of the scale, yielding 15% who indicated sustained collaboration and 12% who refused entirely to take part (Figure 4).

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With 40% on the agreement side facing a 36% group on the disagreement side, opinions on whether the tools affect the interaction between the participants and their fellows are quite discordant, but a majority of 64% of the students noticed an increase of interaction between them and their lecturer. However, 67% reported that, from their point of view, there was an insufficient response to the trend of the mood barometer.

Fifty-one percent of the students agreed on having fun using the e-learning tools and 72% appreciated the regular interruptions of the lecture.

In both surveys, the students were asked to estimate the optimal number of quiz questions per lecture, and both the pre-evaluation and the final evaluation concluded a preference for two to three questions, each suggested by about one third of the group (Figure 7).
Sixty-four percent of the participants declared a benefit from the debriefing after a quiz (Figure 8).

The quizzes also help the students assess their state of knowledge, as 60% indicate. The average ability of the students to estimate, if they have reached the educational objective of the lecture, increased from a 2.9 to a 2.6 on a scale where 1 means “very good” and 5 means “poor” (Figure 9).

The possibility to ask anonymous questions was only sparsely used by about one quarter of the participants, although half of the students declared an increased willingness to ask questions under these circumstances at the beginning of the semester. The most popular reason for not using the question feature is the lack of elaborate questions, whereas the dominant reason for doing so is the consolidated confidence due to anonymity (Figure 10).

4. Discussion

In the following, the results of the surveys, which have been conducted during the last months, shall be discussed. Before starting, the analysis shall be critically examined. First of all, the examination was limited to three lectures, which were all located in the natural-scientific field. Thus, the sample number was very limited and the results probably cannot be extended to other types of lectures, such as humanities ones. Another substantial limitation of the examination is the lack of a control group as the lectures could not be divided, with one part using e-learning tools and another part not using them.

Moreover, the questionnaires were invented by members of the LectureLab team and were not reviewed by experts. Therefore they were not validated and do not comply with the scientific quality criteria of objectivity, validity and reliability (Kirk, Miller 1985). Additionally, the selection of the lectures, using the tool, was not randomized as they were chosen on the recommendation of teaching-experts from ProLehre, who had worked with these lecturers before. As not only the e-learning tools themselves but also how they are applied can alter their impact a lot, this biased selection of participating lecturers limits the examination. The results of this examination can therefore not be applied to every lecture and every type of lecturer. However, the number of participating students and their gender-distribution can be seen as representative for TUM and therefore the results of this examination may serve as an indicative trend.

By being invited at every lecture to answer questions about the last one or about general problems, the students deal with the learning matter very frequently. Therefore it is expected that students who participate in polls by e-learning tools during the lecture not only save the matter in their long-term memory more frequently (Lee, 1973), but are also much better in their self-assessment. They have to ask themselves very frequently if they know the learning matter and therefore it is no surprise that the majority of the students state that their self-assessment has been enhanced by the use of e-learning tools.
Additionally, the students stated that they could extend their knowledge by the use of the e-learning tools. This was also expec-
ted, as every encounter with a problem evokes thoughts around the present problem, establishing links between different aspects and thereby deepening the understanding.

To have an opportunity to ask questions anonymously seems to be not enough of an incentive actually to do so. The participation in the use of the tools in general was relatively limited. The majority of the students stated they would use the chance to ask questions via an e-learning tool but did not do so in the end. As the ma-
jor reason they stated that they did not know how to formulate a good question. This clarifies a problem, which might be rooted in the fact that students nowadays are not instructed in how to ask questions there is almost no space for it in normal lectures and even during high school. Maybe a workshop at the start would be a way out of this problem. In this workshop the students would learn how to phrase a question in a way that is precise and clear, as described in a study by Marbach-Ad and Sokolova (2000). A major point of such a workshop would also be that every student asks questions there and learns the value of doing so and that almost every question is worth while.

The possibility, of students being distracted by the tool cannot be ruled out, but it appears to be a relatively small problem. The ma-

ority of the students stated they would use the chance to ask questions via the mood-barometer tools and not for example to the poll-system tools.

Even though the students were reserved in asking questions via e-learning tools, they stated that the interaction between the lec-
turer and themselves was enhanced - thus the main aim of the project was achieved.

5. Outlook

All in all e-learning tools appear to enhance the learning experience during lectures for numerous students. As the present analysis is limited, more examinations employing a higher number of lectures and including comparable control groups have to be conducted to come to a final evaluation. However, this analysis shows that the learning process can be improved by altering the way of presenting or repeating the latest thoughts. Moreover, the students stated that they could extend their knowledge by the use of the e-learning tools. This was also expected, as every encounter with a problem evokes thoughts around the present problem, establishing links between different aspects and thereby deepening the understanding.

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