EVALUATION OF DIGITAL INTERACTION SUPPORT IN A LARGE SCALE LECTURE

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ABSTRACT

We introduced E-Learning tools in a lecture for computer science freshmen in the winter terms 2002/03 and 2003/04. In both terms, an independent group intensively evaluated the lecture. In the second term, we introduced an interaction tool, which allowed students to interact with the educator. The paper presents the tool, its use and evaluation results.

KEYWORDS

Notebook, Classroom, Interaction, Interaction Support, Evaluation, E-Learning

1. INTRODUCTION

Communication is essential to impart knowledge. In learning, the preferred form is a dialog, allowing the learning person to interrupt at any time in order to ask for a more detailed description of some aspect. The goal of large-scale lectures is to offer much information to many students at the same time. The organizational set-up of large-scale lectures usually prevents the educator from answering more than a small number of questions in each lecture. The usefulness of large-scale lectures based on a monologue held by the educator is debatable. However, administrative and organizational reasons often prevent a different set-up, especially when many students take the same course.

We want to support our students by enabling them to ask questions that the educator notices and is able to address, either during the lecture or afterwards. In our lecture, this was only possible with software support, as we had more than 600 students and little time to address individual questions in each lecture. We therefore evaluated several communication and interaction support tools. Due to the length of this paper, we can only present a small but representative selection of available systems.

Several interaction tools are usable with a web browser. For example, *SWATT* (Student Web Answer Template Technology, Shotsberger and Vetter **(**2001)) is based on HTML Forms. In our experience, using a web browser leads many students to browsing the web instead of following the lecture. In principle, we can avoid this using special firewall rules. However, these also prevent accepted or desired internet use during some lecture, such as literature studies.

EduClick (Liu et al., 2002) is an example for infrared-based systems. It supports multiple-choice quizzes with each student using a kind of remote control. A standard PC running the EduClick software gathers and summarizes the answers. Such systems are typically restricted in the number of supported users, and may be unable to distinguish more than 512 different users. In our large-scale lecture in a large auditorium with changing lighting situations, we did not want to rely on the submissions over distances of 50 meters and more.

A set of tools is available for PDAs. One example for this group is the Personal Java client/server application *WILD* (Wireless Interaction Learning Devices), by Scheele et al. (2004). Here, our special set-up of the wireless LAN infrastructure makes using the tool difficult, as the users need to authenticate using a VPN application that is not available for PDAs. Additionally, according to our poll, only 49 students actually owned a PDA or wanted to buy one. In contrast, nearly 200 students already owned a notebook. Therefore, our software needed to run on notebooks.

2. INTERACTION SUPPORT FOR STUDENTS

We developed an application that students can install on their notebooks as a communication link to the educator. We decided to keep it easy and simple: students should not have to invest time to "learn" the tool, but be able to simply install it and start interacting. Using the tool, students can submit text messages, evaluate a parameter of the lecture specified by the educator, such as the current presentation speed, and answer multiple choice tests (Rößling et al., 2004).

Figure 1a shows a typical configuration of the students' interaction application that offers three essential parts. The availability of the components depends on the course configuration specified by the teacher. The slider at the top evaluates the current presentation speed. With the submit button on the right side, the ranking is sent to the educator.

The text area in the center can be used to enter a message for the educator. The student can choose between three categories of submissions according to the buttons on the right. Each button causes the message to be stored in a database on a central interaction server. The button *urgent* directly sends the message to the educator, enabling him to answer the question during the lecture. If the student sends the message by clicking the button *general*, the message is not directed to the educator during the lecture, but the educator can eventually answer the message by email. The button *tag* places a notice together with the current time-stamp for the student. This can be helpful for later learning steps.

The bottom row contains buttons for multiple choice quizzes or quick votes. An answer can be set by selecting any combination of the answer buttons A, B, C and D. The answer is again submitted by the button on the right.

(a) Student client (b) Educator clients

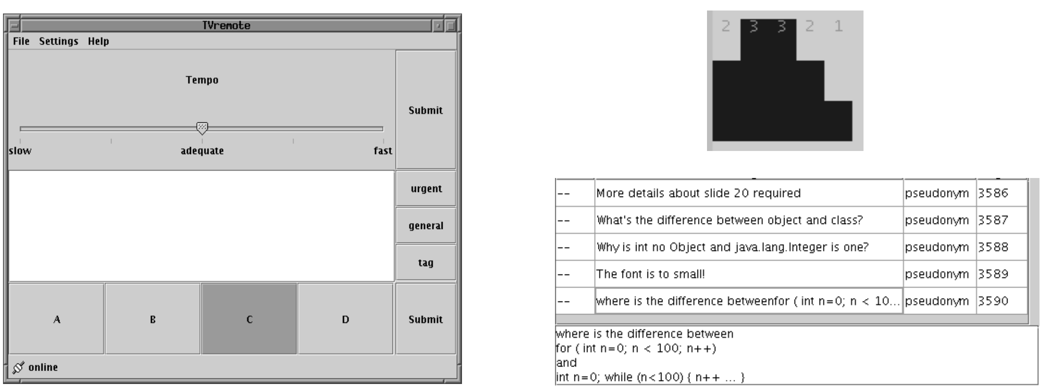

Figure 1: a) Interaction for students and b) excerpt of the educator's view

The educator can use one application to retrieve all three types of interaction. The focus of the educator has to be on the lecture materials. Therefore, the interaction view mostly displays a statistical overview of the evaluation and quizzes / votes, rather than current individual submissions. Figure 1b shows a histogram that visualises participation in the evaluation of the presentation speed. The histogram counts student evaluations and categorises them into five groups from very slow (left) to very fast (right). In this example, eleven students took part in an evaluation. The average result is that the presentation speed is a bit too slow.

The bottom of Figure 1b shows the front-end for submitted text messages. This allows the educator to read incoming text messages and discuss them in the lecture. Each question can also be displayed to the audience. As can be seen in the screenshot, the actual user name is anonymized. This shall reduce the shyness of some students to ask “stupid” questions, as they know that the educator cannot determine their identity. The interaction server can resolve the “anonymous” user to their real mail address. This can be used to prevent abuse or at least react to it, and allows mail-based feedback for questions not addressed during the lecture.

The educator can also select predefined multiple-choice tests in an additional front-end. Quizzes or opinion polls can be performed at any time by projecting the question and the values for the answers A to D. The students answer the test with the buttons shown at the bottom of Figure 1a. Once the educator ends the test, a statistical overview is generated for the educator. This can also be shown to the students as immediate feedback, ideally combined with a short discussion of why certain often chosen wrong answers are in fact incorrect.

3. EVALUATION

In the winter terms 2002/03 and 2003/04, about 650 computer science freshmen each participated in the lecture *Introduction to Computer Science*. The course took place in a large lecture hall twice a week for 90 minutes each. As this was the first course for most students, they were still unfamiliar with university lectures. The educator decided to take a break in the middle and offer the interaction software described above to increase the communication between the students and the educator. Multiple choice tests took place during this break. The educator scanned and addressed the submitted questions both during the break and at the end of each lecture.

The university’s didactical team evaluated the lecture during both winter terms. Technical, organizational and didactical aspects were taken into consideration. A formative evaluation, participatory observations during the lectures and written questionnaires were conducted at various occasions throughout the course of the lectures. A quantitative analysis of student comments was retrieved from the tool’s log files.

The following results were mainly derived from the final questionnaire of the 2003/04 winter semester. They primarily pertain to the technical equipment of the students and their assessment and use of the software. Furthermore, we examined how the communication between students and professors could be increased through the use of the interactive tool during the lecture.

The lecture was initially attended by 650 participants. Over the course of the term, participation dropped to about 400, as is typical for most first-term large-scale lectures at our university. 369 students filled out the final questionnaire to provide the data for the following evaluation results. Most participants studied computer science, computer science and business administration, or mathematics. Thirteen percent of these students were female and the average age was 21.

47% of the students found it difficult to ask a question in a large lecture like the one we surveyed. 45% stated that it would be easier for them to ask questions if they could stay anonymous.

90% of the 369 students owned a personal computer, with 200 (54%) owning a notebook. Many students had Internet access using DSL. Approximately 40% owned a wireless LAN card. To allow the other students to access the network and submit questions, the department of computer science offered 200 additional cards for free lending on a month basis.

During the winter term 2003/04, 92 out of the 200 students owning a notebook claimed to have actually used their notebooks during the lectures. Direct observations of the lectures show that on average, forty to sixty notebooks were in use in any given lecture. 72 students used the interaction tool during the lecture. The following numbers outlining the usage of the tool components should not simply be added, as several students used more than one feature of the tool.

The functionality and user friendliness of the tool was judged as average to good, while the visual layout was only ranked as average. A large part of this is probably due to our decision to keep the tool lean and easy to use, in order to minimally distract the students from the lecture itself.

43 students evaluated the presentation speed often or in nearly each lecture. 39 students participated in multiple choice quizzes. 27 students indicated that they frequently submitted text messages. Although text message submission was clearly the least used feature, students also evaluated it as the most useful feature, giving 4.3 points on a scale between 1 (not useful at all) and 5 (very useful). Many students indicated that they preferred to ask questions during the exercises, in exchange with other students or through the discussion forum, as opposed to during the lectures.

Out of the 72 students using the interaction support tool, only 48 answered the question whether the tool increased the communication between students and the educator. 64% of the 48 students thought that the communication had increased. 20 students each stated that the educator answered questions appropriately and that they were less shy to ask questions because of the tool. Questions were usually answered only in specific breaks in the middle and at the end of the lecture. We conjecture that this had an impact on the perceived usefulness. Some questions were already moot by then, or the students were lacking a crucial piece of information for up to 45 minutes. Alas, this was not evaluated in the survey.

70% of the notebook owners indicated that they used their notebooks at university outside the lectures. Similarly, 80% of the 369 students considered the use of notebooks outside lectures as useful, while only 40% judged notebooks as useful during lectures. This is probably partly attributable to the large lecture hall which offers only a very limited amount of power sockets. Additionally, a notebook takes up most of the individual student's space on the table, preventing effective note-taking on a paper copy of the lecture slides.

4. CONCLUSION AND FURTHER RESEARCH

The majority of students did not use our tool, because they either lacked the necessary equipment or could not see its usefulness towards their own learning process. A small group of students used the tool intensively and judged the ability to send text messages and the rating of the speed of teaching as very useful. Compared to a traditional lecture, the interaction between professor and students increased, but this effect applied only to a limited number of students. However, all students could benefit from the answers given. Alas, this indirect benefit was not evaluated in our survey.

According to our evaluation, the results indicate that the lack of use has less to do with certain aspects of the tool itself (function, usability and layout), than with its didactic integration into the lecture concept. Freshmen students of the faculty of computer science seem to perceive large lectures more as an opportunity to gain content information, than as a place to ask questions and gain a deeper understanding of the material. For them, there seem to be better opportunities for gaining a deeper understanding and discuss the material than during lectures. For example, discussions after the lecture or during exercises with tutors are perceived as more helpful.

To gain a more intensive use of the interactive tools by the students, a change of the opinion of the students with respect to the role of communication during lectures is necessary. We believe that a prerequisite for this is spending enough time answering and discussing the questions and comments during the lecture, as close to the placement of a relevant question as possible. The incorporation of more activating teaching methods in conjunction with the traditional lecture is also helpful. Both aspects are supported by our tool and could cover for example frequent quizzes integrated into the lecture (Scheele et al., 2004). The educator could also hand out specific assignments to be done during the lecture.

Our tool was initially geared for notebook use, as far more students owned a notebook than a PDA. We have meanwhile developed a version of the tool that can be used with Java-capable mobile phones. More than 40% of the students in the winter term 2002/2003 already owned a WAP-capable mobile phone. From observations, we expect that the rate of students owning a mobile phone with or without WAP is probably beyond the 90% mark, even in the first term of their studies.

In our poll, less than 6% of the students were willing to pay the fee for transmitting messages by a mobile phone via GSM or WAP. We are therefore currently working on a solution for transmitting the data using Bluetooth. For this end, we will setup Bluetooth access points which allow the students a free interaction solution without the possible distraction by e-mail, chat, news or browsing the web. We expect that the number of mobile phones with Bluetooth support owned by our students will grow over the years, as this "new" technology becomes common and is integrated into most new mobile phones.

In our experience, educators like to offer this interactive tool. They want to reach the silent crowd or they want to encourage students to ask questions which they usually would not ask.

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