NEW SCENARIOS FOR AUDIENCE RESPONSE SYSTEMS IN UNIVERSITY LECTURES

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ABSTRACT

Mobile devices like smartphones and tablet PCs are widely used among university students and can be used for audience response systems (clicker systems) to improve teaching. Modern implementations of these systems are no longer limited to plain multiple-choice questions, but enable the lecturers to perform a variety of teaching scenarios. We present and discuss two novel extensions for audience response systems, namely *message boards* and *teacher controlled self-learning tasks*. In the former, students can use their mobile device to make comments and ask questions related to a lecture, which are then discussed directly during class. The second extension can be used to build multi-stage learning and exercise scenarios that accompany the lecture. These two techniques bring new pedagogical and technical questions with them. We discuss their large potential and point out some pitfalls we have encountered in our experiments.

KEYWORDS

Audience Response Systems, Audience Feedback, Mobile Devices, Self-Learning

1. INTRODUCTION

Smartphones and tablet PCs are in widespread use among today's students. These devices are permanently used for communication and socializing, and students will swiftly shift their focus to them, as soon as their interest in the lecturer's presentation diminishes. Even though such usage may be undesirable during a lecture, the overwhelming availability of mobile devices can be used successfully in audience response systems (ARS) to overcome the students' fading attention and to enrich teaching. The functionality of these systems has been improving constantly in recent years, and they are no longer limited to plain multiple-choice questions. Message boards and collaborative applications can be used in classrooms nowadays, which raise novel pedagogical and technical questions. When we developed our novel quiz application, the *MQ2* (Schön, 2016) with the capability to support advanced teaching scenarios, we experienced large potential as well as some shortcomings. Out of our developed enhancements, *message board* scenarios and *teacher controlled self-learning tasks* seem particularly promising. In this paper, we present these two extensions of our audience response system and discuss the feedback we got from students and lecturers during the past four semesters.

2. RELATED WORK

With almost every new evolving technology, approaches are made to use it for teaching and learning; mobile devices are no exception. The first available smart pocket PCs brought up the idea to implement device-independent applications to perform quizzes within university lectures. As one of the first systems, Scheele et al. presented the Wireless Interactive Learning (WIL/MA) system to support interactive lectures (Scheele, 2005). It consists of a central server and client software for pocket PCs. A quiz, a chat, a feedback tool, and a call-in module are supported by the system. Major disadvantages are the requirements of a Java compatible hand-held device and the effort to manually install the client software.

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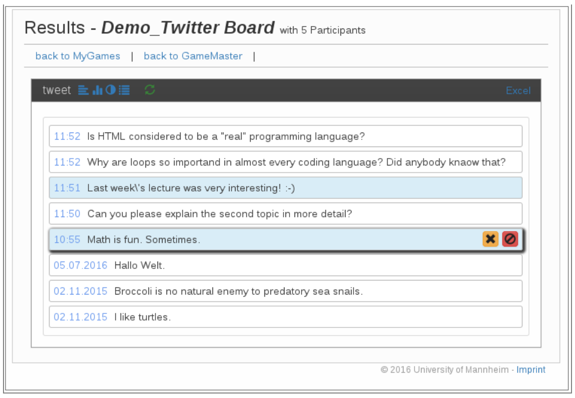

Figure 1. Example of a Message Board with students' comments about live programming in an exercise lecture

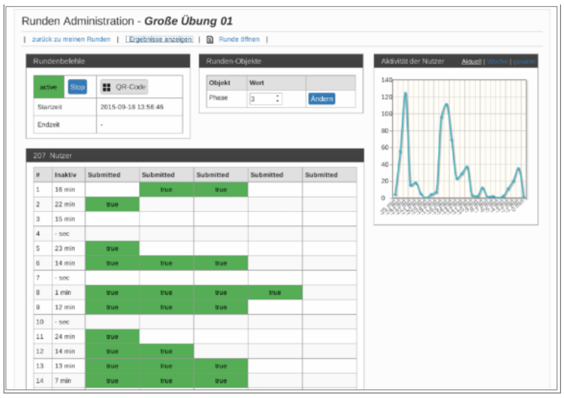

Figure 2. The overview page while running a quiz with five phases. The lecturer can see how many students already submitted the right answers as green colored fields

With the advancement of mobile technologies and hand-held electronic devices, more and more applications have been developed and deployed which run directly on the students' mobile devices (e.g. Abramson, 2013 and Adam, 2014). Most systems use a similar architectural structure: a dedicated interface to create the content and an application for the students' devices that enables the answering and response to the central interface.

Applications like *Clicker* (Rajavel, 2014) or *QuizIt* (Adam, 2014) are only a few examples of the bring-your-own-device era. Abramson et al. showed in 2013 that 86% of undergraduate students at American colleges and universities use laptop computers, while 62% of those students use a smartphone. Buchholz revealed in 2016, that already more than 90% of the questioned students owned smartphones. Therefore, making use of all these mobile devices is an obvious and economic step. By now, the mobile devices evolved in technical functionality and propagation. They not only allow an easy interaction with the device, but also support the visualization and playback of multimedia content like audio, text, images, or videos (e.g. Schön, 2012). This new generation of lightweight ARS can also be used more easily in combination with different learning materials like lecture recordings and e-books (Vinaja, 2014). As students now carry their voting devices anyway and modern ARS usually communicate via the Internet, it became easy to virtually enlarge the classroom and decouple feedback from time and location. Students can participate remotely in virtual lectures or repeat quizzes for themselves when watching a video recording of the lecture.

With the ease of developing Web-based ARS, dozens of new clicker systems appeared. Some systems only require a Web-server where the new applications are hosted, so that they are fast to create and cheap to maintain. In their survey of Web-based ARSs, Kundisch et al. presented as many commercial products like *ActiVote*, *eClicker*, or *i>clicker*, as free software like *PINGO*, *Socrative*, *Kahoot!*, or *inVote* (Kundisch, 2013).

All these systems have in common that they can enrich learning by activating students, by giving the lecturer feedback on the learning progress, and by providing variety in teaching and thereby reducing boredom. But they are very limited in the variety of supported scenarios as they are mostly focused on plain question scenarios. However, the more flexible the systems are, the more useful they can be for teaching as they can be adapted to the lecturer's needs.

3. ADVANCED AND CUSTOMIZED AUDIENCE RESPONSES

In contrast to the applications mentioned above, our novel ARS, the *MobileQuiz2* is capable of performing a large variety of different quiz scenarios on the students' mobile devices. Besides standard single and multiple-choice questions, it supports individual customized quizzes that are defined by a set of rules. Therefore, it enables lecturers to individually customize their quiz scenarios or to create new ones. Among the already created ones are survey scenarios using a Likert-scale, presentation evaluations, and dynamic game-theory experiments. The two most interesting scenarios that we created so far are the *message board* and the *teacher controlled self-learning tasks*.

3.1 Message Board

The *Message Board* is a scenario that supports real-time commentaries from students. The Web-based client provides a short textual description, a text input field, and a submit button. Students enter a comment into the text input field and submit it to the server. The comments are visualized on a Twitter-like message board, where the latest post is shown on top of the list. Figure 1 shows the message board with two highlighted comments that was used in a large computer science exercise in the Fall semester of 2015. About eighty students participated in the lecture. The lecturer explained the exercises while doing live programming of the solutions. The students had the possibility to give feedback to the lecturer and to ask questions by using the message board. After the teacher developed an example code snippet, he evaluated the comments and displayed them in front of the classroom. Within the first ten minutes of one lecture, thirty comments were received and the feedback was discussed immediately. This form of interaction with the lecturer allows students to ask questions, which they are too shy to ask in a large classroom, or to give a dynamic input to the current topic. The teacher can incorporate the questions and comments into the lecture and adapt it to the current needs of the students.

Unfortunately, the perceived anonymity can also lead to annoying behavior, if the messages are not controlled. In our experiment, some students got bored halfway through the lecture and started submitting disruptive messages to the board. Seeing this content on the classroom projection motivated other students to send similar unwanted comments. To prevent the misuse of the system, the lecturer's ability to block inappropriate comments, to highlight noteworthy ones, and to ban students from participation was added. Filtering through the messages in addition to the regular teaching causes an additional cognitive load on the lecturer, especially in large courses.

3.2 Teacher Controlled Self-Learning Tasks

The second scenario enables lecturers to switch through several quiz phases with different tasks that build upon one another. Each phase is started separately. In the scenario of our experiment, the lecturer of the computer science exercise explains the process of converting binary numbers into the decimal and hexadecimal system. The students open the quiz and are presented with the task of converting a given decimal number into the binary system. The answer is entered into a text-field and submitted to the server. The results are evaluated automatically and the students get direct feedback. In the case of an incorrect answer, a second attempt can be made. By using this quiz, students are able to practice the conversion by themselves. The lecturer can watch a list of submitted results as seen in Figure 2 and obtains immediate feedback about the students' level of skill at number conversion. After a discussion of the calculations and the correct results, the lecturer introduces a more complex conversion problem and starts the next quiz phase. The tasks shown on the students' devices change automatically and the students are challenged with a more difficult conversion problem. By continuously being guided through multiple phases of exercises with increasing difficulty, the students are able to practice the learning content and difficulties can be identified and discussed immediately as they arise. Additionally, the tracking of ones student's answers in the course of the phases enables the teacher to identify correlations in the answering behavior. These can reveal causes of students' problems with the contents and needs for additional explanations. So if, for example, many students are not able to answer phase 2 and 5 correctly, there could be a need to go once again back to the more basic contents needed in phase 2.

3.3 Discussion

We performed a separate feedback scenario at the end of the semester, where the students evaluated the steady variety of the mobile teaching scenarios. The lecturer's opinion was collected continually after every scenario usage. Lecturer and students state, that the new scenarios for audience response systems enhance the existing e-learning activities greatly. The participants report seeing the benefit and would like to use more of such scenarios. Nevertheless, several technical limitations of the developed system were recognized. Compared to our basic audience response system, the advanced applications do not scale well and there were complaints about the performance of the system. We observed this problem when more than about 50 students used a complex scenario. Regardless of the scalability issue, the potential of the novel audience response systems is high. Even after experiencing significant performance problems, some lecturers kept using novel audience response scenarios and created new tasks for their future courses. So the interest in and the need for new teaching methods are obviously high, especially when they enable lecturers to customize the teaching on learners' needs by easily accessible means as students' mobile devices.

4. CONCLUSION

We presented two novel scenarios for audience response systems that we developed and tested in different lectures. The message board allows students in large lectures to interact with the teacher and to ask questions and provide feedback. The lecturer can incorporate the feedback into the lecture and adapt the teaching to students' needs. But our experience shows that the messages should be filtered, so that only the appropriate ones are presented in the classroom.

The teacher controlled self-learning tasks are multi-stage learning and exercise scenarios that students use in class. They give students the ability to test their own understanding of the presented material, and allow the lecturer to adapt the pace of the lecture based on students' performance. Unfortunately, they also demand higher requirements on the technical implementation. But they allow a more direct and better-monitored guidance through a set of tasks than usual single phased quizzes.

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