Evaluating Lectures Through the Use of Mobile Devices
Auditorium Mobile Classroom Service (AMCS) as a Means to Bring Evaluation to the Next Level

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Abstract: For lecturers at universities timely feedback from their students is very important in order for them to improve their teaching with adaptations targeted at the students' requirements. Classical evaluation methods address overall evaluations at the end of a semester, commonly with paper-based questionnaires. However, this does not provide direct benefit to the students of that course as adaptations will most likely be carried over into the next iteration of the same course. For this reason, students' motivation to participate in these surveys decreases over time. Therefore, we propose a tool support for continuous evaluation during the conduct of a course available the whole semester, including direct feedback during the lecture, formative evaluation during the entire course, and a summative evaluation at the end of the course or semester. For that purpose, we expanded the functionality of the interactive Auditorium Mobile Classroom Service (AMCS), which was developed to support students in self-regulated learning (SRL) processes during classical university lectures. In the present article the concepts and features of AMCS for evaluation are described. Furthermore, we report first experiences from a field test in two university lectures.

1 INTRODUCTION

Auditorium Mobile Classroom Service (AMCS) is a project that aims at enhancing the quality of lectures by providing support to the students and the lecturer. It addresses problems like the lack of interactivity in huge university classes and facilitates learning in terms of an active, constructive and highly individual process [Seel, 2003].

Based on didactical concepts such as peer instruction [Mazur, 1997] as well as the possibilities audience response systems (ARS) offer [Mayer et al., 2009, Weber and Becker, 2013], AMCS developed certain features, which support students during university lectures in mastering the demands of the learning process. In contrast to traditional ARS and clickers, AMCS is based on a psychological framework describing the learning process of students during the lecture. The different features are derived from models of self-regulated learning (e.g. [Hadwin and Winne, 2001, Zimmerman et al., 2000]). With AMCS the lecturer is able to construct learning questions, surveys and messages for distinctive students in advance of the lecture. These interventions are delivered during the session according to defined rules. AMCS thereby expands the role of the lecturer from a teacher who stands in front of the audience presenting relevant information towards a designer of a learning environment, which contains more than only the presentation in the lecture hall. The AMCS app is used to deliver specific interventions to the students. The main features of AMCS have been evaluated and constantly developed (e.g., [Kapp et al., 2014, Hara et al., 2015]). In the latest version we focused on a feature that addresses the needs of the teacher. In order to help students in the auditorium to successfully learn, teachers have to know more about the audience: their interests, their personal goals, the state of knowledge, their difficulties and their motivation must be considered when designing support. A continuous evaluation in terms of formative evaluation during the course and a summative evaluation at the end of the course is necessary in order to improve the quality of the classes. Therefore, the present contribution reports possibilities to bring evaluation of university classes to the next level via the tool AMCS. We first start with a description of the main features of AMCS. We then elaborate how AMCS can improve the evaluation and

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in what contexts it can be used in order to improve the quality of the lecture. In 4 we present findings from two pilot studies before ending with a conclusion and thoughts about further development.

2 FEATURES OF AMCS

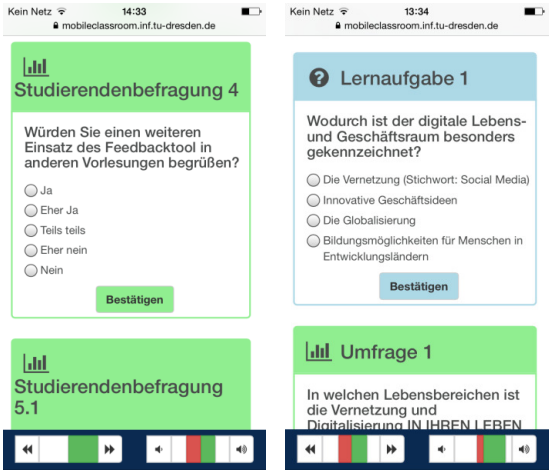
The latest version of AMCS contains six features which basically aim at supporting students in mastering the demands of the learning process. According to [Zimmerman et al., 2000] students have to face various demands during the forethought phase, the performance phase and the self-reflection phase. Students differ with regard to the goal orientation, attribution style and prior knowledge. Therefore, they plan their learning differently (e.g., select specific learning strategies) and process new information in distinctive ways. The evaluation of the learning activity during the self-reflection phase as well as the change of relevant strategies for the next learning activity is also influenced by personal experiences. Whether or not students identify a learning strategy as useless depends for example on their metacognitive skills. The following seven features aim at supporting students during the forethought phase, the performance phase and the self-reflection phase of the learning process.

2.1 Interests / Personal Goals

At the beginning of the lecture students are asked about their personal goals and interests. Therefore, their mobile device presents a few questions addressing for example whether they "are interested in the topic or just need the credit points for the course". An example is shown in figure 1. The answers are stored for each student in a database and are used as triggers for possible later interventions such as messages and learning questions. At the same time, the short survey at the beginning helps students to reflect on their own goals and the lecturer to know more about the composition and motivation of the audience.

2.2 Learning Questions during Lectures

AMCS is able to deliver learning questions at different points of time during the lecture. In contrast to other ARS, AMCS provides individual feedback (the students' individual datasets also allow individual*ized* feedback). Students can answer multiple-choice questions on their smartphones and receive feedback after choosing an option. After the second incorrect attempt AMCS displays the correct answer. The lecturers are still able to display the audience's aggregated results on the presentation screen in case they want to discuss them in public. Along with AMCS comes a tutorial helping lecturers to design learning questions and feedback according to certain construction rules, making them powerful tools to support the learning process both in the necessary cognitive and metacognitive processes. An example of a learning question is shown in 1.



(a) survey (b) learning question

Figure 1: Exemplary survey and learning questions in students' view.

2.3 Metacognitive Prompts

Depending on the students' preference (e.g., exam preparation or interest in the subject), which they indicate in the survey at the beginning of the lecture, strategic guidance is delivered during the lecture. If students stated that their main goal in the present class is to pass the exam, they might receive the following message: "The issue on the current slide is relevant for the exam. The professor may ask . . . ". The intention of metacognitive prompts is to help students to regulate their attention and motivation in order to reach their personal learning goals.

2.4 Cognitive Prompts

The learning questions at the beginning, in the middle and at the end of the lecture contain the possibility to identify students' knowledge gaps. Thus, students who have made mistakes in a learning question at the beginning of the lecture, may receive the following exemplary message containing a cognitive prompt at a later point of time: "You have made a mistake in the first learning question at the beginning. The correct answer is discussed by Prof. Y on the current slide."

2.5 Providing Further Material and Initiating Discussions

AMCS allows sending additional information to the students, such as links, documents, and presentation slides. This happens according to their personal learning goals. Furthermore the lecturer has the possibility to induce and enhance slow discussions by sending personalized messages like “Stand up right now and ask the following question loudly into the room: ‘What is the practical use of this theory?’”. By doing so students can be animated to pose questions which allow them to reach the next knowledge level.

2.6 Facilitating an Immediate and Substantial Evaluation

AMCS offers the possibility to evaluate university lectures on a new level. Compared to traditional ways of evaluation, it allows to collect more information by the means described earlier in this section. Providing learning questions, surveys with different formats, and messages allows gathering data relevant for evaluation. Besides, AMCS also has an extra function for immediate feedback to the lecturer. Students can indicate whether they want the lecturer to in- or decrease the volume, or whether they want to proceed to the next topic or remain on the current slide for some more time. An interface for the immediate feedback is displayed in the lower areas of subfigures 1(a) and 1(b). – This last feature is described in more detail in the next section.

3 BRINGING EVALUATION OF LECTURES TO THE NEXT LEVEL

Evaluation is often realized with questionnaires at the end of trimesters or semesters. Students are asked to answer a set of items, which asked for their judgement of the lecture. The data assessed with these questionnaires are subjective ratings for about 14-16 sessions. If distributed via paper-pencil questionnaires the data analysis takes some more time. Therefore, a discussion about the results of the evaluation is often not realized, results are delivered after the course finished. Furthermore, the summative character of the evaluation makes it difficult to actually provide substantial information for the lecturer about how to improve. Questions like “Did the teacher seem to be prepared for the class?” asked students to rate a characteristic that may vary from week to week. An overall rating at the end of a course indicating the need to improve in that point is useless for the students of the current course and does not provide the lecturer with useful information on how to enhance the quality or to dispose this impression. With that background, AMCS intends to improve lecture evaluation by providing information which are available over longer time periods as well as immediately during and after single lectures. Furthermore, AMCS improves the quality of evaluation by providing more valid information through the use of various data sources. The functionalities AMCS offers for evaluation can be categorized by A) the point of time, the evaluation takes place, and B) the type of data that is used. In the following chapter these two dimensions are described.

3.1 Point of Time

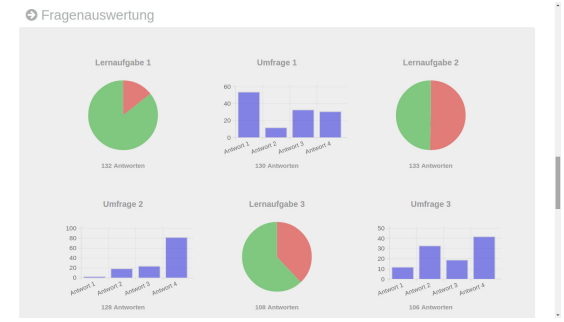
In contrast to the conventional evaluation of courses at the end of a semester, the evaluation with AMCS allows formative evaluation during the lecture and after single lectures as well as a summative evaluation at the end of a whole course.

3.1.1 During the Lecture

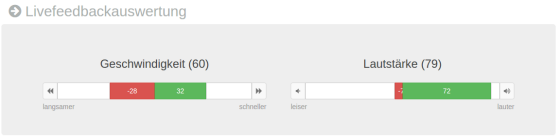
Lecturers can use some information to improve their presentation during the session. As they are normally busy with explaining content to the audience the interface which presents any kind of evaluation information should only contain the most necessary information and do not interrupt the lecture. AMCS presents results of the live-feedback (volume and speed) and displays the learning question results of the students (as shown in 2). Especially within the breaks in which students work on learning questions (see 2.2) the lecturer can check how much students did understand the current topic (by having a look at the learning question results). For the instant feedback we are currently developing a smartwatch application which feeds back the most important information in ”real-time” to the wrist of the teacher.

3.1.2 After Single Lecture

Detailed analysis of learning questions, surveys and live-feedback about the speed and volume allows the lecturers to get a valid idea what just happened in the lecture hall. By considering all used learning questions (as shown in 2), one could discover what the audience did understand and what should appear at the beginning of the next session when it comes to recapitulation of important concepts. By asking certain questions via the survey tool students can articulate concerns, wishes or questions. Furthermore, a



(a) results of learning questions



(b) evaluation of instant feedback

Figure 2: Results of learning questions (upper subfigure) and instant feedback (lower subfigure).

combination of data facilitates a deeper insight into the knowledge states of the audience. If the lecturer asked at the beginning of the class what interests the students have and what career they are studying, it is possible to analyze the data for each sub-population and identify needs of groups of people. An aggregated presentation of live-feedback data allows identifying critical moments or content within one session. In 3 the speed ratings over one 90-minute session with 33 presentation slides are shown. That way the lecturer can reflect on parts where the audience seems to have experienced difficulties.

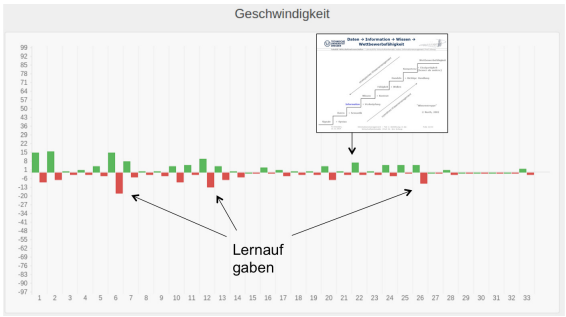


Figure 3: Aggregation of live-feedback ratings for one 90-minute session.

3.1.3 After Course/Trimester/Semester

AMCS is able to realize the traditional evaluation surveys at the end of a whole course. The supported formats contain scale questions, questions with a free text field, multiple and single choice questions. As the database stores answers for every user over the time of the whole course, analysis can reveal learning progress by taking a look at the learning questions.

As AMCS can be used by simply registering a pseudonym and a password, the evaluative feedback can be considered equally as safe as a traditional paper&pencil evaluation from the privacy perspective. Privacy concerns remain on the usual and commonly agreed upon as acceptable level of non-attributable identifiers such as IP address or user agent string.

3.2 Type of Data

AMCS allows lecturers to assess different kind of data in order to understand what happened in their class. To demonstrate the evaluation possibilities of AMCS these different methods are described in the following section.

3.2.1 Surveys

The traditional surveys, which are often used for evaluation, can be distributed with AMCS. The lecturer can design questions (single-choice, multiple-choice, free text, scale) in advance of the session and define at what point these questions are displayed on the mobile devices of the students. Thus, it is possible to assess subjective ratings of learning progress, satisfaction with the teacher and the progress in class or judgments about the circumstances (see 4).

3.2.2 Achievement Data

The results of the learning questions represent valid data about the knowledge state for each student who participated. The lecturer should have in mind, that the learning questions might have to be designed with another purpose than achievement assessment. For instance, learning questions at the beginning of a lecture might serve as hints for the upcoming class they might indicate what concepts are relevant and important and thereby guide the learners' attention. In that case, the learning question would ask for content, which has not been taught, yet. The chances of solving the learning question successfully in the first attempt should be relatively low. Thus, the lecturer should not take this result as an indicator for learning achievement. Still, learning questions at the end of the class or at the beginning of the next session addressing content, which has been taught, can serve as diagnose tool to assess the knowledge of the audience. Thereby, they supplement self-judgments of learning achievement and progress of the surveys and add an evaluation dimension, which is extremely useful for teachers. Over- and underestimation of own

knowledge and skills is a common problem amongst students.

3.2.3 Live-feedback and Utilization Data

Live-feedback data and log-files indicating how often students worked on learning questions or participated online in questionnaires etc. can be used to trace difficult parts or sessions over the semester. As shown in 3.1.2 and 3 the live-feedback can help in identifying content, which is perceived as difficult. Statistics about the number of students who have been online during the session and who worked on the learning question reveal interesting data about the participation over the semester.

4 PILOT-TESTS

The evaluation features were tested in two different courses, 1) a computer science lecture, and 2) an "introduction to economics". In the first test, AMCS was used for three 90-minute lecture sessions in a row. The professor used several learning questions and asked the students to evaluate the lecture at the end. Over the three sessions 140 user accounts were registered. As the registration did not have any restrictions some users created multiple accounts. In case they forgot their login, they just created new ones in the next session. Hence, the amount of created accounts does not represent the number of students who actually participated. However, we always had between 45 and 55 answers for the questions, so we can estimate that there were around 50 active users per lecture. In the second test, two 90-minute sessions gave the professor opportunity to utilize learning questions, survey questions and live-feedback. In the first session 186 users were registered, in the second 139.

In both courses students were introduced to AMCS at the beginning of the first session. It was explained that AMCS aims at supporting their learning process in the lecture, that the participation is voluntary and that the prototype and the project is still under construction. In test scenario one we aimed at evaluating the potential of surveys and learning questions, in test two the focus was on the live-feedback data and learning questions.

4.1 Results of Pilot-test One

Scenario one addressed the potential of learning questions and surveys for the evaluation. In the first session students were asked about their career and their motivation/personal goal in the lecture. 28 students answered: 20 studied computer science, 5 economics, two studied non specified other careers and one education. Nine students stated that they were interested in the topic of the lecture ("because they are using video- and streaming services…"). Twenty-three indicated that their motivation to visit the lecture is to pass the exam at the end of the semester. Two were interested in writing a bachelor or master-thesis about the topic of the lecture, and five expected the lecture to be valuable for their work as systems developer or programmer.

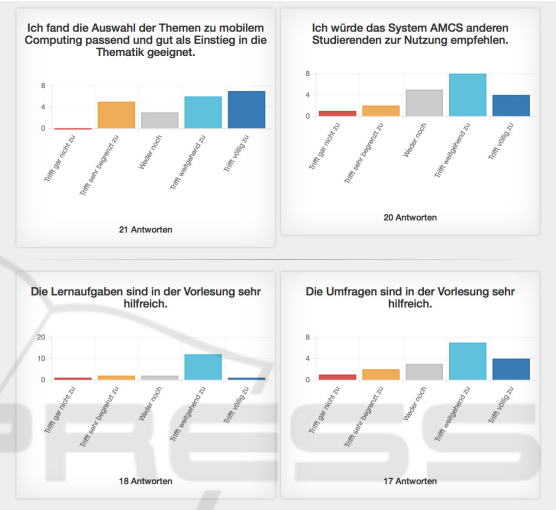


Figure 4: Survey in pilot test in computer science lecture. (a) "The selected topics about mobile computing were suitable as starting point for beginners." (b) "I would recommend using AMCS to other students." (c) "The learning questions during lecture were very helpful." (d) "The surveys during lecture were very useful."

The information about the different interests and personal goals of the students could be used for a differentiated analysis of the evaluation and learning questions. For example, the lecturer could filter the results depending on the field of study and could determine if students from a special field have more problems than the others. The professor as well as the students rated the learning questions as a useful tool to identify problems and knowledge gaps. At the end of the third lecture the students were asked about their opinion about the selection of the topics in the lectures as well as about the helpfulness of using AMCS especially learning questions and surveys in the lectures. Their feedback were predominately positive.

4.2 Results of Pilot-test Two

Scenario two addressed the potential of learning questions and live-feedback data. Within this pilot-study

the students could judge during the whole 90-minute session whenever they had the feeling that the professor was going too fast or too slow, or the volume was not adequate. The data suggested that the live-feedback is a tool that is used only in case of problems. In the two sessions of the economy course students used the possibility to give feedback regarding the volume only three times: At the beginning of the first lecture, during the first lecture when the professor was showing a video with poor sound quality and at the beginning of the second lecture. At each of these three points around 20% of the students judges the volume as to low. Concerning the speed of the professor there was only in the first session a significant feedback activity (with more than 5% of the registered and active students voting). Students used the speed buttons to feed back to the professor if they need more time to work on the learning questions. The professor had prepared six learning questions, which were distributed in blocks of two questions. Around 20% of the students voted during this breaks that they want the professor to go on faster (if they had already finished working on the learning questions) or to go slower (if they need some more time). The evaluation activity diminished in the second session. One explanation is that students noticed that the professor was not immediately changing his teaching. That points out that there is the need of an interface which gives relevant information back to the lecturer (see section further development).

According to the professor, the results of the learning questions gave him a useful overview about the knowledge state of his audience. Students appreciated the possibility to work on learning questions as well. They even judged them to be more useful than the live-feedback tool.

5 CONCLUSIONS AND FURTHER DEVELOPMENT

AMCS provides opportunities to support students to evaluate the lecturer and their teaching. The presented features mainly aim at fostering regulation and mastering demands of self-regulating learning of the students. But they also can be used for the formative evaluation during and after the lecture. The lecturers can receive instant feedback – i.e., information in real-time during each lecture – they can react to directly during a lecture, e.g. by adapting their presentation, but they can also receive evaluative feedback – i.e., a summary of comments and opinion after the conclusion of each lecture – in order to make some changes after the course or semester have ended. The first pilot tests have shown that learning questions, cognitive and metacognitive prompts, and instant feedback can be used in university lectures in order to support students in mastering the demands of this learning situation as well as lecturers to improve their teaching. At the end of the semester lecturers will be provided with an overview of all events, allowing an overall evaluation of the entire lecture or tutorial series.

In the next development steps we will focus on the representation of the evaluation data to the lecturer. We will provide more features for the aggregation and visualization of the evaluation results. In order to provide the real-time feedback without too much interruption of the presentation, a second device – i.e., a second screen – would be helpful; also, a smartwatch could be utilized.

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REFERENCES

Braun, I., Kapp, F., Körndle, H. and Schill, A. (2015). Onlinegestützte Audience Response Systeme: Förderung der kognitiven Aktivierung in Vorlesungen und Eröffnung neuer Evaluationsperspektiven. In *Proceedings of the Wissensgemeinschaften in Wirtschaft und Wissenschaft 2015*, 153–165.

Dubrau, M. and Krause, J. (2015). Mobiles Feedback - Praxisbericht zur Integration eines Audience Response Systems in eine Lehrveranstaltung als Instrument der Lehrevaluation. *Proceedings of the Wissensgemeinschaften in Wirtschaft und Wissenschaft 2015*, 167–171.

Hadwin, A. F. and Winne, P. H. (2001). Conotes2: A software tool for promoting self-regulation. *Educational Research and Evaluation*, 7(2-3):313–334.

Hara, T., Kapp, F., Braun, I., and Schill, A. (2015). Comparing tool-supported lecture readings and exercise tutorials in classic university settings. In *Proceedings of the 7th International Conference on Computer Supported Education (CSEDU 2015)*, pages 244–252.

Kapp, F., Braun, I., Körndle, H., and Schill, A. (2014). Metacognitive Support in University Lectures Provided via Mobile Devices. In *INSTICC; Proceedings of CSEDU 2014*.

Kapp, F., Narciss, S., Körndle, H., and Proske, A. (2011). Interaktive Lernaufgaben als Erfolgsfaktor für E-Learning. *Zeitschrift für E-Learning*, 1(6):21–32.

Mayer, R. E., Stull, A., DeLeeuw, K., Almeroth, K., Bimber, B., Chun, D., Bulger, M., Campbell, J., Knight, A., and Zhang, H. (2009). Clickers in college classrooms: Fostering learning with questioning methods in large lecture classes. *Contemporary Educational Psychology*, 34(1):51–57.

Mazur, E. (1997). *Peer Instruction: A User's Manual*. Prentice Hall, Upper Saddle River, NJ, series in educational innovation edition.

Seel, N. M. (2003). *Psychologie des Lernens: Lehrbuch für Pädagogen und Psychologen*, volume 8198. UTB, München, 2. Auflage edition.

Weber, K. and Becker, B. (2013). Formative Evaluation des mobilen Classroom-Response-Systems SMILE. *E-Learning zwischen Vision und Alltag (GMW2013 eLearning)*.

Zimmerman, B. J., Boekarts, M., Pintrich, P., and Zeidner, M. (2000). Attaining self-regulation: a social cognitive perspective. *Handbook of self-regulation*, 13–39.