Exploring Classroom Response Systems in Practical Scenarios

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Abstract: The increasing number of students per classroom requires new ways of interactions betweens teachers and students. Classroom Response Systems (CRS) aim to solve this problem by enabling feedback for large audiences. We defined and identified requirements of a viable solution and present Tweedback as a example of modern Classroom Response Systems. Tweedback is a web application and provides different types of feedback: A chatwall, where the audience can ask questions, a panic-button to provide immediate feedback on the lecturers presentation and multiple choice questions. Tweedback has activeley been used since January 2013. The feedback of our users and our own practical experiences allowed us to identify several issues of Classroom Response Systems and develop suitable solutions.

1 Introduction

The number of students at german universities has increased substantially in the last two decades, from 1.7 million in 1990 to 2.6 million in 2013 [SB14]. As a result the number of students per classroom increased the same way. For some courses a single lecture hall isn't enough anymore so lectures are streamed to different classrooms simultaneously. These circumstances call for an adapted method of interaction between students and teachers. In small classrooms students can interact directly with their lecturer, but with large audiences direct communication is limited to only a few students. There are several reasons for this. The large number of students makes it impossible to get feedback from each of them in a reasonable time. Another reason is that students might be afraid to ask or answer questions in front of large audiences, because they feel uncomfortable or don't want to give a wrong answer.
One strategy to re-establish a viable feedback channel in classrooms of this size are Classroom Response Systems (CRS). Classroom Response Systems provide different types of feedback [GVC13] and can be used with large audiences. Some of them provide only one form of feedback, for example multiple choice questions [KL09]. Others combine different forms of feedback. The authors developed a Classroom Response System called Tweedback. Tweedback is implemented as a web application and provides three forms of

feedback. Firstly, a chatwall where students can post questions. Secondly, different kinds of multiple choice surveys. The third one, a Panic-button to provide immediate feedback on the lecturers presentation. We rolled out the first version of Tweedback in January 2013 . Since then we received a lot of feedback from our users which helped us to identify general problems of Classroom Response Systems in general and missing features of Tweedback. In this paper we will focus on practical scenarios, experiences and issues of our system.
This publication is organized as follows. In the second chapter we will define the requirements of a Classroom Response System that is able to solve the described problem. Chapter three gives an overview of the state of the art of Classroom Response Systems and the forms of feedback they provide. Section four introduces Tweedback and its functions in detail. Section five focuses on practical experiences, user feedback and issues of Classroom Response Systems. The last section summarizes our work so far and outlines our future work.

2 Requirements

At first, a feasible solution has to be easy to set up, even for a non-technical person. A complicated and time consuming setup discourages users to participate in Tweedback. Especially teachers with no technical background might have problems to handle the system under time pressure. Solutions that use an extra device, as a remote control, are very time consuming to set up. The devices have to be maintained and distributed before and collected after every lecture. Another disadvantage of using hardware devices is bad scalability because there has to be a device for every student. Hardware device-based solutions only scale with the number of remote controls.
Tweedback is a feedback system for large audiences hence scalability is an important criteria. Unlike traditional feedback systems which rely on special external devices to interact with each other Tweedback uses devices that students already have. Administrators only need to take care of our backend so that it can handle the appropriate amount of browsers. According to Bitkom [Bit14], 78% of young german pepople own an internet-capable smartphone, hence Tweedback is implemented as a web application. That lowered the administrative effort and financial cost of our solution and made it much easier to maintain. The downside of this decision is that a permanent internet connection is required. Closely linked to an easy set up is an interface which is fast, intuitive, user friendly and suitable for mobile devices.
Tweedback is designed to lower the inhibition threshold for our users as much as possible. Therefore we dispensed a user management system and the corresponding initial account creation procedure. This decision results in a further advantage. Without an account it is not possible to link the interactions of Tweedback users to real persons. Anonymity is a very important characteristic of Tweedback. People might be afraid to give a wrong answer or to ask questions in front of large audiences, especially first year students.

3 State of the Art

Traditional Classroom Response Systems (CRS) have been used as voting machines: Teachers asked a multiple choice question and students answered them by clicking on a remote control that provided buttons for each answer [KL09]. As these voting devices are very expensive and have to be maintained, modern CRS use the mobile devices students already have. Since mobile devices, as smartphones, pads or notebooks, provide a display that can draw more than just buttons for multiple choice questions, CRS evolve to comprehensive feedback systems that are able to implement more enhanced functions for feedback [DCC02] [FBSB12] [Jen07] [KSZ+12] [VGC13]. This section provides an overview of current modern Classroom Response Systems and concludes their similarities and differences.
On the one hand there are several academic, free implementations of modern CRS as ARSNova[1], inVote[2], myTU[3], Pingo[4] [KSZ+12], Smile[5] [FBSB12] and Tweedback[6] [VGC13]. All of them, except myTU, have at least the function to ask multiple-choice questions. Furthermore only Pingo does not provide a mechanism to rate teachers' speech parameter, whereas all others do. The possibility for students to ask questions is only provided by myTU, Tweedback and Smile. On the other hand there are non-academic modern CRS, which require a fee to use them. Common representatives are TopHat[7], Ombea[8] and Letsfeedback[9]. All three provide at least a function to ask multiple choice questions [VGDC14].

Regarding the inhibition threshold all of the presented CRS require a registration process for teachers to use the system. Only Tweedback allows anyone to use it's functions without any registration. Moreover all of them are accessible either using a web browser or an app on iOS and/or Android. Concerning the anonymity, all of these modern CRS allow students to provide their feedback anonymously, or at least using a pseudonym [VGDC14].

4 Tweedback

Tweedback is a scalable, web based CRS whichs main purpose is to provide feedback channels between lecturers and their students. Users can access Tweedback through any internetcapable device with a webbrowser. It is designed to be used with large audiences and easy to set up.
The following section we will introduce the three different functions Tweedback provides. All functions can be activated separately in order to minimize distraction through unnec-

[1] https://arsnova.eu
[2] http://invote.de
[3] http://mytu.tu-freiberg.de
[4] https://pingo.upb.de
[5] http://www.smile.informatik.uni-freiburg.de
[6] https://twbk.de
[7] https://tophat.com/
[8] http://www.ombea.com/
[9] http://letsfeedback.com/

essary items on the screen.
The first function is called Chatwall [VGC13]. The participants can post questions to the Chatwall or leave any other kind of text based feedback (Figure 1). Users can read every post on the Chatwall and hide them if they are irrelevant. Especially large audiences can produce several postings per minute which makes it impossible for the lecturer to read them all while giving a presentation. Therefore users can upvote postings which are especially relevant to them. Postings with the most votes are displayed on top of the Chatwall so the lecturer can see the most relevant postings at a glance. This sorting-mechanism minimizes the distraction that the lecturer has to deal with. Teachers are also able to fade out postings, as a result these postings don't appear on the Chatwall anymore. Furthermore it is possible to mark postings, so lecturers can revise all interesting posts after the presentation and find unanswered questions. There might be very helpful questions on the Chatwall with a low vote count because they don't seem to be relevant to the majority of students.
It is also possible to sort the Chatwall to show the newest posting first. This sorting-mechanism is intended to be used by students so they don't miss any new questions. In order to keep the questions short and clear we limited the maximum posting length to 140 characters. We also added a three second timeout between two postings to prevent distracting spam messages.

Figure 1: Chatwall - Student view

The second function provided by Tweedback is the Quiz [GVC13]. Teachers can start different kinds of surveys during the presentation. Tweedback supports simple yes or no questions as well as multiple choice questions with two to five choices. The current answer distribution is visualized in real time (Figure 2) until the lecturer closes the quiz and publishes the results. The audience can only see the published results to avoid an influence of the already given answers on the future answers.

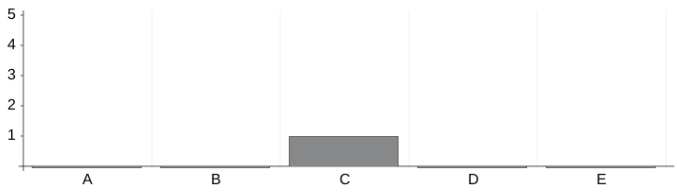


Figure 2: Quiz - Teacher view

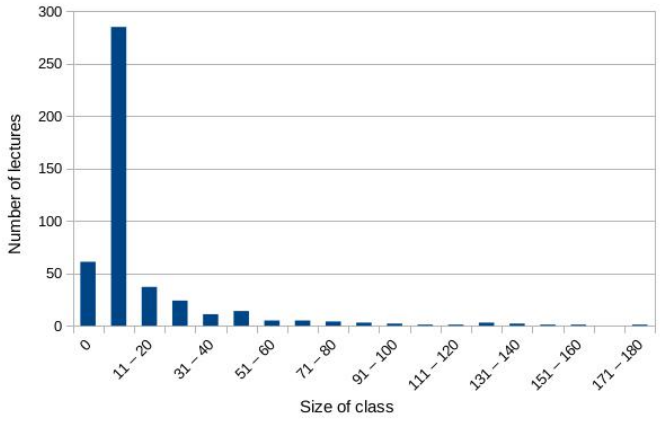
Besides Chatwall and Quiz the audience can provide feedback via the Panic-button. There

are multiple scenarios where a user can press the Panic-button, sometimes also referred to as stop button [GVC13]. The lecturer might be to fast, explained a complex issue in an incomprehensible way or any other situation that makes the user feel uncomfortable. As seen in figure 3, the lecturer gets a graphical interpretation of the current situation in his lecture. The more people press the Panic-button, the bigger the graph grows. The x-axis represents the time and the y-axis the ratio of pressed Panic-buttons to participating users.

Figure 3: Panic Button - Teacher view

5 Observations on Practical Use

We rolled out the first version of Tweedback in January 2013. Since then, Tweedback has been used by 3466 unique users and 16 lecturers of the University of Rostock. There might be other external lecturers among our users but due tue our privacy policy we can't identify them through our logfiles. Figure 4 shows the number of lectures for a specific class size. The real class size might be a bit higher because we counted the logged on devices instead of students present in the classroom. 175 users participated in Tweedbacks biggest lecture so far.



5.1 Exploring Non Technical Problems

Both user groups, lecturers as well as students, provided a lot of helpful feedback. The given feedback helped us to identify unknown problems or missing features of Tweedback. The feedback from lecturers and students also revealed a very different perception of communication in classrooms. Some lecturers argue that most students are not afraid to ask or answer questions in front of the class, whereas almost all students hold the opposite point of view. Especially first year students are afraid to embarrass themselves with wrong answers or ask questions in front of the class.
One particular problem was reported from both, lecturers and students. Teachers tend to focus so much on their presentation that they forget to check the provided feedback channels. They miss new Chatwall posts or feedback via the Panic-button. Especially feedback provided by the Panic-button is closely linked to the current situtation in the classroom and gets less usefull with every passing minute. The lack of response from the lecturer discourages the students from participating. At the moment we are analyzing several strategies to overcome this problem. One approach would be to use an acoustic or optical signal to get the lecturers attention. Another possible approach is a notification by a smartwatch. A smartwatch is similar to a smartphone. It is a small mobile computing device with a touchscreen and is worn on the user's wrist. The smartwatch can communicate with other devices and the user can install applications to expand its functionality. Tweedback's notifications are shown on the smartwatch's display.

Some lecturers also reported another serious issue. Contrary to our expectation the setup and use of Tweedback overwhelmed them. A few struggled to comprehend the full functionality of Tweedback instantly, so they missed important information. For example they stopped multiple choice quizes even though less than 50% of the students had voted for an answer. Other lecturers misinterpreted the function of the Quiz and expected to be able to specify their own custom answers instead of using the standard multiple choice answers (A-B-C-D-E).
This problem occured more frequently with teachers from non-technical faculties. However even lecturers of computer science without any CRS experience struggeled with Tweedback. There is a technical and non-technical approach to this problem. The lecturers can participate in a workshop or briefing (non-technical) or work through an interactive tutorial on their own (technical). Both approaches are intended to make the users familiar with the setup and functions of Tweedback, as well as the best practices on how to use a Classroom Response System in reality [BVC14].
The limitiation of one post every three seconds per student in combination with our voting-mechanism proved to be an effective anti-spam strategy. The character limit per posting forced the users to keep their questions short.
We also received suggestions for new features to implement in future versions of Tweedback. Students from technical disciplines suggested a support of Latex to post formulas on the Chatwall. Others asked for a reply function so users can answer chatwall questions. We will evaluate the pros and cons of these suggestion and implement them if appropriate.

5.2 Technical Problems

We faced different technical problems during the development and testing of Tweedback. Our biggest problem, besides temporary server downtimes, was the insufficient WiFi coverage in some classrooms. The WiFi coverage in most tested classroom is usually very good so there have been no problems at all. Students and lecturers were able to use Tweedback without a hitch. Classrooms which are not covered with WiFi are not usable for Tweedback. As mentioned in an earlier paper of our research group the lectures of medical science are given in rooms of the hospital with its own WiFi for managing patient's data. The patient data have high security requirements therefore only a few areas of the hospital provide an open WiFi access [GVC13]. In cooperation with the local IT administration we installed access points in the hospital to provide a sufficient coverage to use Tweedback. Unfortunately it is not feasible to equip every room with a sufficient number of access points before setting up our system. This strategy is very expensive and time consuming. It also contradicts our goal to offer an easy to set up Classroom Response System.
Tweedback can be packed into a more flexible and more practicle solution, the Tweedbag. The Tweedbag is an all-in-one solution. It consists of a small computing device, for example an Intel NUC, and an access point. The computing device runs a local Tweedback instance and the access point manages all WiFi connections. The lecturer only needs to plug in the power cable and turn on the computing device and access point. We suppose that the Tweedbag solves the problem of insufficient WiFi coverage and also provides a very handy and portable all-in-one solution for conferences and other events.

5.3 The Limits of Tweedback

Every system has its limitations. In case of Tweedback or Classroom Response Systems in general most of them are related to the size of the audience. It does not make sense to use Tweedback in combination with a very small audiene. In that case a direct interaction between all participants demands significantly less effort. Even though Tweedback focuses on large audiences, at one point an audience can be too large for Tweedback. Features like the Panic-button and the Quiz are not limited in number of participants, but the Chatwall loses its use when the lecturer is flooded with incoming messages.
Another limit of Tweedback is closely linked to the lecturers presentation style. Some lecturers prefer to walk around the room most of the time and interact with their audience from face to face. They get their direct, but limited, feedback directly from the audience and a Classroom Response System would interfere with their presentation style.

6 Summary

In order to handle the increasing number of students in classrooms new ways of interactions have to be established. We defined and identified requirements of a viable solution and presented Tweedback as an example of modern Classroom Response Systems. Tweedback provides three forms of feedback to enable interaction between students and the lecturer. Firstly the Chatwall, secondly the Quiz and thirdly the Panic-button. The feedback provided by our users and practical experiences enabled us to improve Tweedback's usability and to identify unknown issues of Classroom Response Systems. In the future we will further investigate strategies to lower the user's inhibition threshold and ways to notify the lecturer about recent Tweedback activites. Furthermore we will continue the Tweedbag's development and perform tests to evaluate the advantages and disadvantes of this approach.

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