Chapter 4
Designing and Developing a Student Response System for Mobile Internet Devices

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ABSTRACT
The authors present a Student Response System for modern Internet-capable mobile devices, which was developed in a European R&D project, co-funded by the European Commission. The goal was to make a system that is designed for speed, ease of use, and flexibility for use in lectures. The authors have tried to make a time efficient and intuitive system that does not compromise flexibility and that enables the teacher to use any lecture format he/she sees fit. The only requirement is a computer with an Internet connection; the teacher is not bound to specific presentation software. The system is Web-based, enabling students to use their own mobile device or computer. The cost for both educational institutions and students is kept at a minimum, lowering the threshold for using the system in education. As of today, the program is free of charge and can be found at histproject.no.

INTRODUCTION
A common challenge with traditional class lectures is the communication between teacher and students (Masikunas, Panayiotidis, & Bruke, 2007) and student interactivity (Draper & Brown, 2004). This is especially prominent at college and university levels where lectures often consist of large classes. With classes of up to hundreds of students, direct communication with the students becomes difficult, not only because of the size of the classes, but also because of time constraints.
Many students also find it difficult to give feedback or ask questions during class because of fear of being embarrassed in front of their peers (Geski, 1992; Gleason, 1986). The lack of student feedback during class can make it difficult for the teacher to assess if the students understand the subject being taught (Trees & Jackson, 2007). Students are rarely given time to reflect upon what is being taught in traditional lectures and their understanding of the material is rarely tested during class (Masikunas et al., 2007). This can result in a spiral where the students do not understand part of the lecture and risk losing a significant portion of it because of the inability to catch up. In addition to this, students’ ability to stay focused falls dramatically after about 20 minutes, a factor that can amplify the spiral (Caldwell, 2007; Duncan, 2006).

One way of dealing with these challenges is using a Student Response System (SRS) (also referred to as Classroom Communications Systems, Electronic Voting System, Class Response Systems, and Audience Response Systems), a technology designed to provide communication and interactivity in large classrooms (Beatty, 2004). In a nutshell, an SRS is a technology that enables the teacher to ask questions to the students, often in the form of multiple-choice problems, and the students respond with a small handheld device, often referred to as "clickers". Responses can be given anonymously, lowering the threshold for student participation in the classroom. Studies have shown that anonymity is a key factor for students having a positive evaluation of lectures in large classrooms (Wulff, Nyquist, & Abbott, 1987) and many students appreciate the anonymity of the responses given from SRS (Trees & Jackson, 2007; Stuart, Brown, & Draper, 2004). Teachers can get feedback showing if the students follow the lecture as well as give students time to reflect upon the subject and see if they understand what is being taught (Dufrense, Gerace, Leonard, Mestre, & Wenk, 1996; Stuart et al., 2004).

There are several methodical approaches for using a Student Response System, for instance, Peer Instruction (Mazur, 1997). Students are given conceptual quizzes during class where they first give individual responses (without talking to their peers), followed by a discussion in small groups and respond once more. The teacher then goes through all responses and explains the correctness and incorrectness of the alternatives. Another approach is to omit the first vote and go straight to group discussion followed by a class-wide discussion among both students and teacher (Dufrense et al., 1996). For more methodical discussions of use of SRS, see Horowitz (1988) and Crouch (2001). For a comparison of the methodical approaches mentioned above, see Boyle and Nicole (2003) and Nicole and Boyle (2003). Several studies of SRS show that the students are satisfied with the opportunity to discuss in class and that they are given a chance to reflect and think about the subject being taught (Hansen, 2008; Masikunas et al., 2007). They see the benefits of SRS and usually do not mind that time is taken away from the ordinary lecture in order to be used for discussing and teacher explanation of quiz alternatives (Hansen, 2008). However, there are negative to dead-time, usage of lecture time that does not benefit to learning (waiting for the system to start, handing out clickers, technical problems and so on) (Caldwell, 2007; Hansen, 2008).

Most common commercial SRSs have consisted of systems that use either infrared- or radio senders and receivers, and some form of dedicated software. This is either stand-alone software or a plugin in common presentation software like PowerPoint, the latter being the most common solution. Infrared- and radio-based SRSs have several cost- and practical-based disadvantages. Receivers have to be installed in each classroom using the system, or at least a mobile receiver has to be brought each time the system is going to be used. These systems are often expensive when both receivers and clickers have to be bought, and
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