AC 2011-2121: THE MOBILE PARTICIPATION SYSTEM NOT JUST ANOTHER CLICKER

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Lecture Engagement:
The Mobile Participation System – *Not Just Another Clicker*

Abstract

Electronic student response systems have become common in institutions of higher education as a means to encourage student engagement, mainly in large lectures. Research has shown that such engagement increases student interest and subsequent learning of the material. To manage this interaction logistically, students use specialized, handheld electronic devices, similar to remote controls, to interact with the instructor.

The Mobile Participation System (MPS) is a response system that reinvents student-instructor interaction through a web-based interface, mobile-phone applications, and text messaging, allowing students to respond to questions posed during lecture with cellular/mobile phone devices. The main advantages of the MPS system are: 1) it allows instructors to interact with students during lecture, 2) it allows students to use devices that they already own, 3) it allows students to respond to not just multiple-choice, but also open-ended questions, and finally 4) it can be used to enhance distance-learning classes.

The goal of MPS is to both serve as an effective Student Response System (SRS), while also providing a means to analyze SRS use in higher education. The first phase of MPS development studies the student's perception on its use in the classroom. This data is presented in our paper, in addition to the structure of the Mobile Participation System. The paper also includes a data analysis on MPS effectiveness, as well as several case study applications.

1. Introduction

Many institutions of higher education have begun using electronic Student Response Systems (SRSs) to engage students in the learning process. This is especially true for large lectures, where the traditional one-way instructor-to-students communication makes the logistics of engaging each individual rather difficult. Crouch et al.[2] (2007) show that students are able to retain more information through SRS engagement. In addition, Cadwell[1] argues that students in large classes are often hesitant or unwilling to openly participate because of a fear of public mistakes, a fear of embarrassment, or a fear of peer disapproval. These fears are eliminated with the use of an SRS, as anonymity is an inherent feature of these response systems. While it is already widely accepted that student response systems have been shown to increase student learning, we provide additional references and survey papers on the subject in §2.

While a variety of commercial student response systems already exist, we provide an overview of the Mobile Participation System (MPS) developed at the University of Michigan. We illustrate its superiority when compared to other currently available systems.

The remainder of this paper is organized as follows. In §2 we provide an overview of the literature that has focused on showing the effectiveness of using an SRS. In §3, we provide a detailed exposé on how the Mobile Participation System functions, including an explanation of the underlying technology. Next, in §4 we provide a brief explanation of the features included in the MPS that are not found in other student response systems. In §5, we discuss the implementation of the MPS in an undergraduate engineering course, including the feedback received from students during this course. Finally, in §6 we offer conclusions pertaining to the effectiveness of the MPS, as well as future work illustrating additional class adaptation and feature development.

2. Literature Overview

In this section we explore the vast literature that exists on using student response systems in higher education. A study performed by Hall *et al.*[3](2005) observed positive results when a student response system was used within a large introductory chemistry course. In this study, student performance on exams increased through the use of SRS. Students noted feeling more engaged and responded that their sense of meta-cognition increased.

Research performed by Graham *et al.*[4] (2007) provides insight into how the specific use of SRS affects student perception of the systems. Students were more likely to feel positively about the system when it was used to provide them with feedback on their understanding instead of being used to grade or record attendance. This is a key fact that is explored specifically by our Mobile Participation System.

Investigation by Preszler *et al.*[5] (2007) found that student response systems had a greater appeal for students in lower-division courses than for students in upper-division courses. The study also found that asking a greater number of SRS-based questions in each lecture yielded improved performance on exams.

Research performed by Siau *et al.*[6] (2006) found that student response systems are effective in an information technology course, specifically a course covering systems analysis and design. As the course was composed of both undergraduate and graduate students from varying academic disciplines, the study provided data on the effectiveness of SRS for students representing diverse academic backgrounds.

For additional information, we refer the reader to the survey paper by Cadwell[1] (2007). This article provides a general overview of the available literature on the use and evaluation of audience response systems. In addition, Cadwell illustrates some of the best practices that should be considered when beginning to teach a large lecture using one of these systems.

3. Technological Overview

The Mobile Participation System is built on a web-based architecture using a database-oriented model. More specifically, at the center of the system resides a server that collects all of the students' responses across several mediums, including the following: 1) a text messaging gateway, 2) a website, and 3) smartphones (application-capable devices). In addition, the

instructor interacts with the same server from an administrative screen. This interaction is illustrated in Figure (1) below, and is explained further in this section.

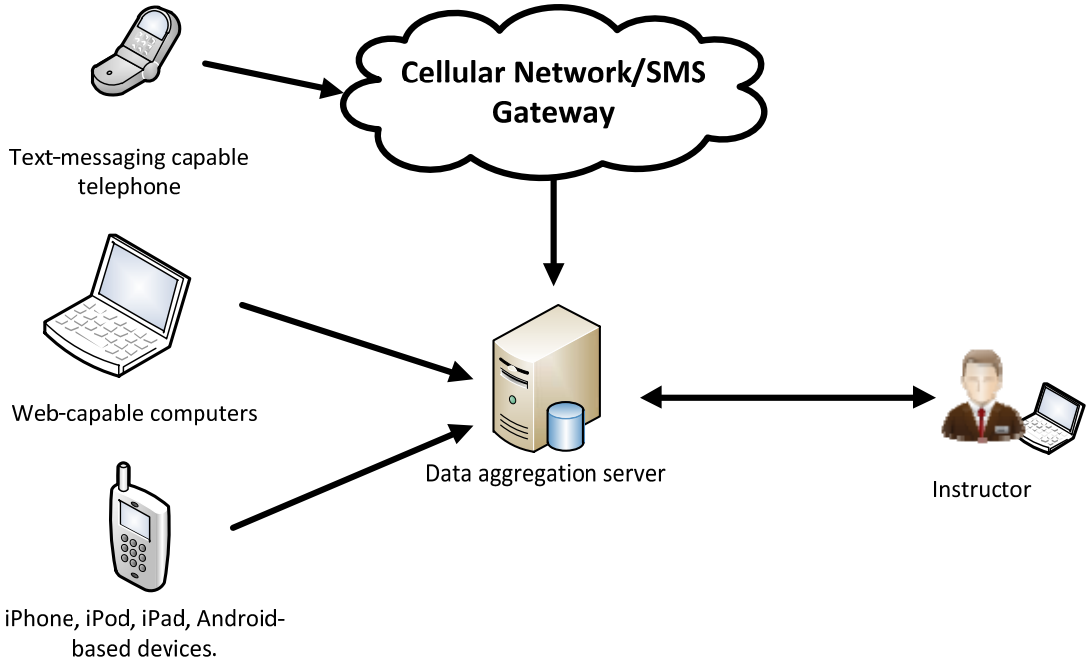

Figure 1: Diagram of the interaction between participants and the instructor of the MPS.

Student Responses

Students have several options to interact with the Mobile Participation System. The emphasis when designing this system was to provide students with a low-cost, if not costless, method of participation in lectures. As a result, the focus of the system is to engage students using devices that they already own. Students can interact with the MPS using three categories of devices:

1. **Mobile Phones** – Students can respond to questions posed by the instructors using text messages, also known as the short messaging service or SMS. To respond, students simply text their answer to a 5-digit short code (i.e. a shortened telephone number) with their desired response. It should be noted that most students have text messaging plans and do not incur extra charges. Actual data regarding the number of students with text messaging plans was collected in an introductory course and detailed further in §5.

2. **iPhone/iPod/iPad and Android Smartphones** – Many student possess high-powered mobile devices ranging from smartphones to iPods. The MPS provides an installable application, also referred to as an app. For example, a student who owns an Apple iOS device is able to browse the Apple AppStore for the MPS app, which is free to download and install. Again, the number of students who possess these portable smart devices is rather high. More specific information regarding the specific number of students possessing such devices is detailed in §5.

3. **Laptop/Desktop Computers** – Finally, a third method by which students can interact with the MPS is by navigating to a website using a laptop or desktop computer.

These three types of devices provide a wide range of possibilities to actively interact with the instructor. This also includes the option for students who are participating in distance learning. Furthermore, our implementation has shown that most students are able to utilize one or more of these devices to interact during lecture, effectively making this approach a no-cost system, which has obvious benefits to all students.

Server Processing

Behind the scenes resides a server that provides all the processing for both the student and instructor interactions. On the student side, the server is responsible for two primary roles: data gathering and data aggregation/grouping. The server drives all three response methods illustrated in Figure (1) above and provides the capture mechanisms that store responses in a database. In addition, responses are computed, grouped and aggregated based on the question type. This is referred to as post-response processing.

Instructor Data Retrieval

The server also provides the instructor with an interface that the he/she can use to drive the system. As a primary function, this interface allows the instructor to complete the following tasks:

1. Create a new course for which to capture data.
2. Design questions for use during lecture. See Figure (2) below.
3. Control the question interface and display the results to the audience. See Figure (3) below.

The administrative platform allows the instructor to seamlessly control the MPS. This simple web-based interface makes the system incredibly easy to use and provides cross-platform compatibility.

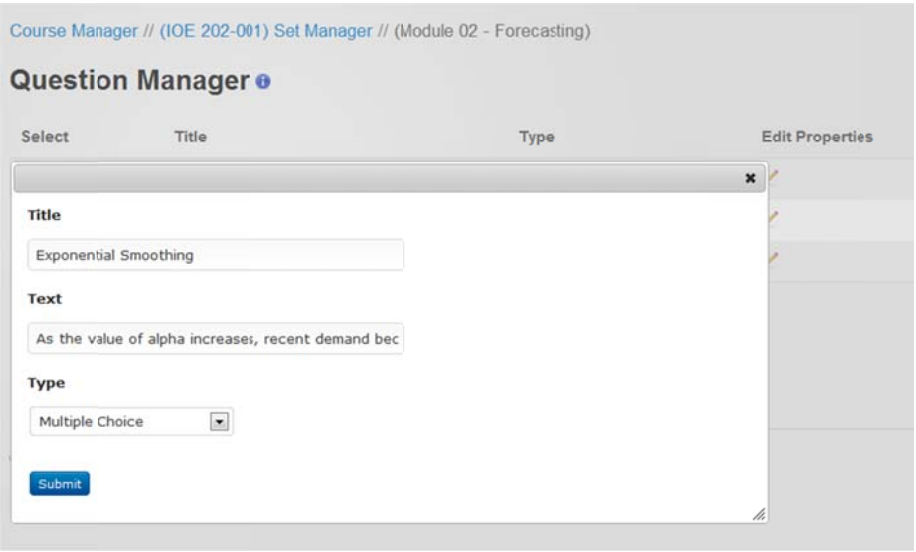

Figure 2: Question manager interface to be used by the course instructor.

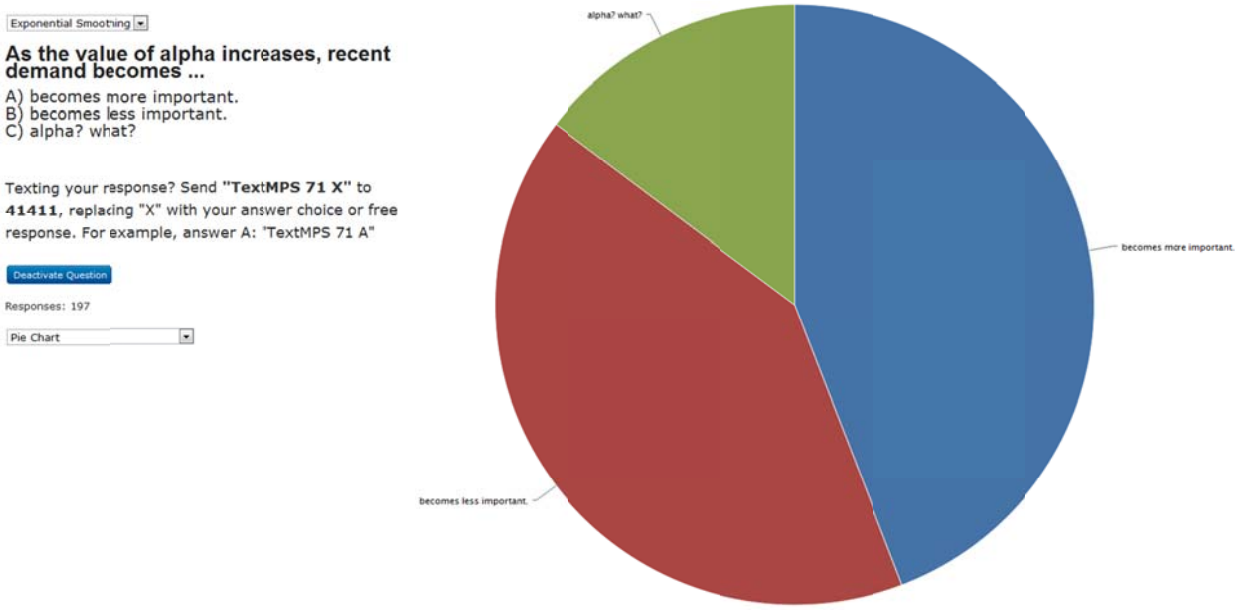

Figure 3: Active question interface to the displayed during lecture.

4. Feature Selection

As noted in §2, many implementations of student response systems exist today. However, the Mobile Participation System provides several features that are currently not offered in other devices. It is these features specifically that make the MPS superior to other technologies for engaging students in lecture. In this section, we will explore the differentiating features between the MPS and other commonly found audience participation systems.

Multiple Question Types

Traditional student response systems feature a hardware device that allows students to choose from several possible answers to an in-class question. This device corresponds to the commonly used multiple choice question presented during lecture. While effective, a multiple choice question may not be desirable in every situation. As such, the MPS is designed to handle open-ended questions. For example, an instructor may pose the following statement:

Provide the value of pi to the nearest hundredth digit.

Students can then submit their response using any of the input methods that the MPS provides (text-message, smartphone device, or laptop computer). If the question type is a free response, the server performs its post-response processing and aggregates similar answers. For example, if two students responded with the same answer of 3.14 to the previous statement, these two responses are then grouped and aggregated. On the administrative side, the instructor is able to see that two students provided the correct answer of 3.14. This grouping not only functions with numerical responses, but also text-based responses where an instructor can pose an open-ended question.

Inclusion of Distance Learners
Traditional clickers require a considerable classroom infrastructure investment. This includes hardware receivers that are required to capture student responses. Furthermore, this hardware investment restricts responses to only those that are collected from within the classroom. The MPS solves this problem through its modular web-based architecture.

Questions posed in lecture can be answered not only by those students who are currently in lecture, but also by those who may be attending the lecture through a video-conferencing system or distance learning program. Such interaction is not available with a traditional student response system since physical presence within the classroom is required.

Eliminate Device Purchase
One of the main benefits to students and institutions is that the Mobile Participation System leverages devices that students already own. This eliminates not only the installation of expensive receiver hardware within classrooms, but also relieves students of the burden of purchasing additional devices.

Many different types of input devices are supported by the MPS platform. Based on our use of the MPS in an introductory engineering lecture, all students were able to use at least one (if not more) of their personal devices to participate. More results from this case study are presented in §5.

Text-message Response
Compared with traditional student response systems, the MPS provides various methods for capturing student responses. Based on our implementation and collection of student data, the predominant method of choice was through text-messaging, a method that is not found in other student response systems.

A Certain "Coolness" Factor
While perhaps not scientific, the Mobile Participation System does have a certain "coolness" factor associated with it. Based on student evaluation of the system, a combination of using new technology and being able to participate as a large group has a certain entertainment factor that makes students particularly interested in using the system to respond. Further student comment results are shown in §5 below.

5. Implementation Case Study
The Mobile Participation System began its initial trials in an undergraduate, sophomore-level, industrial engineering course. The course featured an enrollment of over 130 students and covered the following topics: inventory management, forecasting methods, linear programming, simulation, and queuing theory.

Throughout the Fall 2010 semester, the MPS was used to assess a student's ability to recall knowledge from the previous lecture. The pedagogical reasoning behind this approach was twofold. First, recalling information from a previous class quickly returned students to the current topic of discussion. Second, from an instructor perspective, asking students to recall material helps verify that the topics presented previously were sufficiently learned.

It should be noted that the use of- and participation in the MPS was not required. This was done for several reasons. First and foremost, this was the first "live" trial of the MPS system. As such, requiring student participation may have caused problems wherein the system would not function as expected and could have created additional logistical complications. Furthermore, while more than 95% of students were capable of participating with their mobile devices, the remaining 5% would have had to incur some expense. As such, students were asked to form pairs in order to ensure that at least one of the students would be able to respond.

Assessing Student Capabilities

Prior to the start of the course, students were asked a series of questions to provide information regarding their access to various communication technologies. These included questions such as the following: Do you have mobile phone capable of sending text messages? If so, do you have a subscription that allows you to send an unlimited number of text messages? The goal of posing these questions was to assess each student's ability to use the MPS without incurring any additional charges. The results of these questions can be seen in Table (1).

Table 1: Student capability overview

Students with some Text-Messaging Capabilities	**94.5%**
Students with Unlimited Text-Messaging	80.1%
Students with Limited Text-Message but willing to use up to 30 messages for participation.	19.8%
Students without text-messaging capabilities.	0%

Evaluating Student Participation

At the end of the semester, students were asked about how they participated in class with respect to the MPS. Furthermore, students were asked whether there were any benefits from using the MPS system. The following questions in Table (2) were given to the students after the semester had completed and grades had already been assigned.

Table 2: Student evaluation of the MPS

Question	Student Response
I used the MPS system whenever a question was posed in lecture.	36.6% answered all questions. 30.0% answered most questions. 33.3% did not participate with the MPS system.
I used the Apple iPhone/iPad app to respond to questions.	19.4% used the iPhone/iPod/iPad smart-phone application to respond.
I used text-messages to respond to in-class questions.	70.9% used text-messages to respond.
I used the Android application to respond to in-class questions.	9.7% used the Android smart-phone application to respond.
The MPS is easy to use.	90.6% responded: agree.
The MPS helped me stay engaged during lecture.	43.7% responded: agree. 43.0% responded: neutral
The MPS system helped me think	60.1% responded: agree.

critically about the question and its respective answer.	39.9% responded: neutral.
I would have liked more use of the MPS system during lecture.	50.0% responded: agree. 34.3% responded: neutral.

6. Conclusions and Future Work

Previous research has shown that student response systems engage students, particularly in large lectures where it can be difficult to engage individual students. However, current student response systems have several shortcomings that severely limit the instructor's question making creativity and require substantial financial investment for both the institution, as well as the student.

In this article, we have discussed a new student participation system, the Mobile Participation System. Three core features make the MPS superior to other response systems: 1) it allows for distant-learner participation, 2) students can answer open-ended questions, and 3) students and institutions are not required to make a monetary investment to adapt this technology. We fundamentally believe that this system has the ability to change the way students interact with instructors in large lecture-based courses.

A former student who participated in the course that used the MPS noted the following:

> *"… I can see this becoming a useful tool. Plus I like that it does not require me to purchase something similar to a [commercial clicker]"*

Future Work and Longitudinal Studies

Thus far, the Mobile Participation System has only been adopted in a single course to test its overall functionality and to assess each student's ability and willingness to use such a system. Given the overwhelmingly positive responses presented in §5, the MPS will be applied widely among several courses in future semesters. The goal of this wider adoption is to gather additional data on the effects and usefulness of this student response system, particularly in large lectures such as an introductory engineering course that regularly enrolls more than 200 students.

We plan to again implement the MPS during several classes during the coming semester, as well as keep adding additional features to the system. For a demonstration of the system, we encourage you to visit the following YouTube channel:
http://www.youtube.com/watch?v=6HKuH3pq58E

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