AC 2009-165: USING CELL PHONES AS AUDIENCE RESPONSE SYSTEM TRANSMITTERS IN CIVIL ENGINEERING CLASSES

Paul Richards, Brigham Young University

Using Cell Phones as Audience Response System Transmitters in Civil Engineering Classes

Introduction

Most university students and faculty have cell phones. A *Harris Poll* in 2008 found that more than 90% of adults in the United States have cell phones.[1] Ownership rates are higher among university students, approaching 100% on some campuses.

All these phones result in potential distractions in the university classroom. Campbell and Russo reported that students frequently complain about the distraction from ringing during class time and that university classrooms are perceived to be one of the least acceptable places for mobile phone use.[2] Another survey by Campbell found that most university students and faculty would support university policy against mobile phone use during class time.[3]

Although cell phone ringing can be a classroom distraction, the nearly universal ownership of cell phones might contribute to learning by providing new ways to communicate in class. For example, current technology permits an instructor to collect responses from students in class via text messages and process the responses immediately. This functionality is similar to that of handheld transmitters used in audience response systems that have been successfully integrated into some university classes over the past decade.

The next two sections are additional background that review the use of audience response systems in engineering curriculum and describe how cell phones can be used as audience response system transmitters. The paper then describes a pilot study investigating the use of cell phones as audience response system transmitters in university classes.

Audience Response Systems in Engineering Curriculum

Teaching with audience response systems usually involves asking the class a multiple-choice question, receiving responses from the students via handheld transmitters, displaying the responses with a computer projector, and then discussing responses.[4,5] Audience response systems have been used for several years to improve learning and student participation in university classes. Initial studies showing the effectiveness of audience response systems were reported in the late 1990s and a number of publications have appeared since then. A review of the literature about audience response systems is provided by Fies and Marshall.[6]

Much of the research on audience response systems has been conducted in science classes. Reported use in engineering classes has been limited to mechanics classes with similar content to physics classes (e.g. statics and dynamics). In an introductory dynamics class, Van Dijk et al. found that individual response, without peer discussion, was less effective than response coupled with peer discussion.[7] In a statics class, Nicol and Boyle found that while technology supports active learning, many of the advantages of this style of learning could be retained even without an audience response system.[8]

The nature of upper-division engineering classes may reduce the benefits of audience response systems. Upper-division classes tend to be smaller than introductory-level classes, making it less necessary for instructors to use an electronic system to get responses from all students. Material from upper-division classes may also be more challenging to represent in multiple-choice questions. Beatty et al. discuss some challenges associated with developing effective multiple-choice questions for use with audience response systems.[9]

Cell Phones as Audience Response System Transmitters

The website www.polleverywhere.com facilitates the use of cell phones as audience response system transmitters. An instructor can set up a multiple-choice problem on the website with codes (five-digit numbers) associated with each possible response. In class, students are given the problem with the codes for the possible responses. After students pick their responses, they

send text messages with the corresponding codes to a receiving number. On the website, the text message responses are displayed on a plot. This plot is updated as responses are received and can be displayed with a projector for the class to see. It takes only a few seconds for the text messages to be received and the plot updated. The website provides free service for activities involving fewer than 30 respondents, and charges a small subscription fee for users who need to accommodate more.

Cell phones offer several advantages over traditional audience response system transmitters. First, since cell phone ownership is nearly universal and many classrooms are equipped with a computer and projector, no additional cost is required to implement the system. Second, since students own cell phones and usually carry them, there is not an additional device for them to remember to bring to class. Third, since there is no student financial investment, there is no expectation that the audience response must be used frequently, eliminating pressure to force all material into multiple-choice questions.

While cell phones offer advantages as transmitters, having cell phones "out-in-the-open" during class may result in increased cell phone distractions, exacerbating an existing problem.

Objective

A pilot study was conducted to investigate the use of cell phones as audience response system transmitters in upper-division civil engineering classes. This paper describes the pilot study, including: the classes, types of questions that were used, student sentiment about using cell phones in class, and the impact on cell-phone-related distractions in class.

Methods

In the two classes used for the study, in-class group activities had been emphasized in the two-year period prior to the study. The first class was a graduate class about the seismic design of steel buildings, with a typical enrollment of 15-25 students. The second class was an undergraduate steel design class with a typical enrollment of 40-60 students. During the two

years prior to this study, students regularly worked in small groups during class on design problems and reported answers that were then discussed. The method of reporting was typically turning in a calculation sheet. The instructor reviewed these sheets as they were received and discussed a few representative solutions.

The pilot study introduced the cell phone as a new mode of submitting answers to in-class worked problems. After completing an in-class activity, one member of each group would submit the group's response via a text message. A graph showing all the group responses was displayed and then various answers were discussed. The in-class problems were similar to those used in previous years; the only difference was how the responses were submitted and integrated into the discussion.

Cell phone response was not used exclusively in the two classes. In the graduate class, the audience response system was used on three occasions during the semester. Students were told participation was optional and some students chose not to participate. In the undergraduate class, the audience response system was used on seven occasions during the semester. All groups were expected to participate. On days when cell phone response was not used, groups submitted their solutions to in-class activities by turning in calculation sheets, as had been done in previous years.

Two of the questions used in the undergraduate steel design class are presented below. These questions provide a sense of the in-class problems that students responded to in the pilot study.

Question 1: Estimate the average live load in this classroom right now (lb/ft^2).

a. less than 5
b. 5-10
c. 11-15
d. 16-20
e. more than 20

The purpose of this question is to help students understand what live loads are in typical situations and appreciate how those loads compare with the service loads typically used in design. Some variability is expected in the responses, but this serves to encourage class

discussion. The majority of students compute (b), which is probably the right answer, but it is interesting to hear what assumptions lead students to pick (a), (c), or (d). The students notice that no groups that do a realistic calculation pick (e).

Question 2: Referring to Figure 1 (below), none of the bolts will fail under the loads indicated. Rank the bolts according to how near they are to failure (closest-to-failure … furthest-from-failure)

a. III, IV, II, I

b. III, I, IV, II

c. III, II, IV, I

d. III, IV, I, II

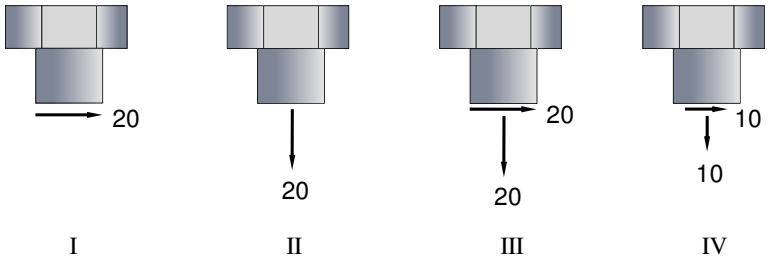

Figure 1 – Visual that accompanies question 2

This question is used to introduce the concept of shear-tension interaction in bolts. Students should be able to identify that sequences (a) and (c) are incorrect, because bolts are stronger in tension than shear so (I) should not be last in the sequence. Sequences (b) and (d) force the students to make a judgment about what happens when shear and tension are both applied.

Surveys were used in the graduate and undergraduate classes to quantify student sentiment about cell phones in the classroom. In the graduate class, students completed a short anonymous survey in class (20 completed) about whether they participated and, if they didn't, why not. In the undergraduate class, students completed an eighteen question anonymous survey in class (54 completed). The undergraduate survey had questions about student perception of cell-phone-related distractions in the class, student sentiment about using cell phones to respond to in-class

activities, and student beliefs about whether electronic reporting of group activities offered benefits over traditional paper-based reporting.

Results

Results from the graduate class survey about participation are presented first. For a variety of reasons, 5 of the 20 students in the graduate class did not participate by sending text messages. Reasons for not reporting were: don't own a cell phone (1 student), don't know how to send a text message (1 student), and have to pay money for each text (3 students).

More interesting data were collected from the undergraduate class. The survey questions and results (as a percentage of respondents) are given in Table 1. For some questions the results do not sum to 100% because of rounding. The following paragraphs discuss three questions in the context of the survey results.

First, are students distracted when others use cell phones in class? In general, as long as the phone use is quiet, most students are not distracted by others using phones. Less than 20% of students find it distracting when other students use cell phones in class for texting, email, or internet browsing (question 7, Table 1). Also, while 48% of students observed a cell phone being used in the study class for purposes unrelated to class at least once weekly (question 17), only 4% agreed with the statement "In this class, generally I believe that cell phones are a source of distraction" (question 12). Only 32% of students said they would agree with a university policy against cell phone use during class time (question 6); this result is much lower than that reported by Campbell in 2005, who found that the strong majority of students surveyed said they would favor such a policy.[3] Campbell's data was collected when cell phones were used almost exclusively for talking, which probably explains the difference.

Second, how did students feel about using cell phones as audience response system transmitters? Students enjoyed responding by text message and almost all agreed that seeing the responses of the other groups was helpful (questions 8 and 9). Students who had used traditional audience response systems in other classes said that they preferred using their own cell phones over other

transmitters. Some reported that they participated better when cell phones were used, but most felt it made no difference as compared to paper-based reporting (question 10).

Table 1 Undergraduate Class Survey with Results (as percentage of respondents)

	Yes	No
1. Do you have a cell phone?	100	0
2. Do you typically have a cell phone with you in class?	100	0

	None	1-5	5-20	More than 20
3. How many text messages do you send in a typical week?	15	15	31	39

	Daily	2-3 times a week	Once a week	2-3 times a month	Once a month	Less than once a month
4. Regarding classes at BYU in general, how often do you observe others using cell phones in class for purposes unrelated to class?	43	44	0	4	6	4
5. Regarding classes at BYU in general, how often do you observe cell phones ringing or vibrating noticeably in class?	9	48	26	6	9	2

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
6. I would agree with a university policy against cell phone use (talking, text messaging, etc.) during class time.	6	26	24	33	11
7. I find it distracting when students use cell phones in class for texting, email, or internet browsing, even if they are not making noise.	2	17	7	59	15
8. In THIS class, I like it when we report group answers with text messages.	33	44	19	4	0
9. In THIS class, it is helpful for me to see the responses of the other groups (the results graph) as we discuss the questions in class	48	46	4	2	0
10. In THIS class, I participate better when my group reports via a text message as compared to days when we don't	17	24	56	4	0
11. In THIS class, I learn about the same whether we send in answers by text message or not.	4	54	28	11	4
12. In THIS class, generally I believe that cell phones are a source of distraction.	0	4	20	59	17

	Always	Sometimes	Never
13. If I get my cell phone out during an in-class activity, I check other text messages or missed calls.	15	35	50
14. How often are you the one in your group to send in the text message?	9	67	24
15. How often is your group unable to send in a message (no phone, no ability)?	0	11	89
16. How often is your group unwilling to send in a message (doesn't want to participate)?	0	13	87

	Daily	2-3 times a week	Once a week	2-3 times a month	Once a month	Less than once a month	Never
17. In THIS class, how often do you observe others using cell phones in class for purposes unrelated to the class?	2	9	37	7	11	13	20
18. In THIS class, how often do you observe cell phone ringing or noticeable vibration during class?	0	11	19	13	11	13	33

Finally, do cell phone transmitters increase in-class cell phone distractions? The survey indicates that having phones out for use as transmitters increases the amount of quiet phone use, but does not disrupt students beyond those who misuse their own phones. When students get out their phones for an activity, a few will check other text messages or missed calls (question 13). Still, the survey results and the instructor's observations indicate that additional unrelated use on days when phones were used was not noticeable or distracting.

Faculty Perspective

The instructor's feelings about cell phones in class were very similar to the feelings reported by the majority of students. In general, using cell phones for audience response was more enjoyable than paper-based responding. In some cases having results electronically collected and displayed facilitated much better discussion, but most of the time there was minimal impact on student learning. The instructor did not notice quiet cell phone use, so any that occurred, including the additional amount due to having phones out for class, did not represent a distraction. Ringing disturbances were similar to classes where cell phones were not used – about once monthly and unrelated to whether phones were used for in-class activities that day. The instructor plans to continue using cell phones for audience response in large undergraduate courses (more than 40 students) on days when effective multiple-choice questions can be developed to stimulate discussion.

Summary and Conclusions

A pilot study investigated the use of cell phones as audience response system transmitters in two civil engineering classes. Data from student surveys quantify student sentiment about using cell phones in class and the impact on cell-phone-related distractions in class. While the study is limited, the data provide some interesting discussion points.

For the classes studied, using cell phones as audience response system transmitters provided some benefits without introducing significant distractions. Students enjoyed reporting solutions to group problems by text message and found it helpful to see how other groups responded. The

instructor found that having results electronically collected and displayed sometimes facilitated better discussion. Unrelated cell phone use in the classroom that was quiet (text messaging, email, internet) was likely higher than usual during in-class activities, but this type of use was not widespread or perceived as a distraction by the students or instructor.

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