Classroom Polling Systems in Upper Level Transportation Engineering Classes: A Pilot Study

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Abstract – With the emphasis on active learning techniques growing, engineering faculty continue to search for effective ways to involve students during class. According to vendors, classroom polling systems offer increased interaction between student and teacher, helping to improve learning by changing the classroom experience. With the advent of second-generation systems, response pads are no longer limited to A-E choices, but now offer numeric inputs with decimals, significantly improving their applicability to engineering courses. This paper presents the results of an informal before-and-after student opinion poll regarding their experience with a classroom polling system. In general, the results were positive, indicating that such systems may indeed provide for an improved learning environment.

Keywords: active learning, classroom polling system, classroom response system, clicker

BACKGROUND

With the emphasis on active learning techniques growing, engineering faculty continue to search for effective ways to involve students during class. No longer a "new idea" in college-level education, active learning concepts have become more of a mainstream focus of faculty development workshops, evidenced by the fact that an internet search on this term returns a significant number of university websites. While a specific discussion of the basic principles of active learning is outside the scope of this paper, basic primers with additional references can be found at the National Teaching and Learning Forum[A] and the Center for Teaching, Learning, and Technology[B].

In this culture of emphasis on active learning, products are becoming available which claim to improve the classroom environment. One such product is the classroom polling system (CPS). These systems include hand-held units for each student and a centralized receiving system which can receive, summarize, and display inputs from students in near real time. According to vendors, these systems offer increased interaction between student and teacher, helping to improve learning by changing the classroom experience. With the advent of second-generation systems, response pads are no longer limited to A-E choices, but now offer numeric inputs with decimals, significantly improving their applicability to engineering courses.

The most significant question is: can these devices truly improve student learning? Most of the current research seems to focus on applications in K-12, rather than the collegiate environment. Are the concepts presented in upper-level engineering courses compatible enough with the capabilities of the polling systems, even with second-generation pads?

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PROJECT PURPOSE AND SCOPE

This paper presents the results from a pilot study performed during the Fall 2008 semester in two upper level transportation engineering courses at Tennessee Tech University (TTU): CEE 3610 Transportation Engineering, a junior level required course for all CEE majors; and CEE 4630 Traffic Engineering, a senior level elective course. During the test semester, CEE 3610 began with 20 students and finished with 18 while CEE 4630 began and ended with 6 students.

Students were provided response pads for two weeks during the course. TTU recently adopted as its standard the CPS-RF pad from eInstructionC, shown in Figure 1. As a second-generation polling system, this pad provides full numeric input, including decimal values (using the <sym> key).

Figure 1. CPS-RF Pad by eInstruction

Both immediately before and immediately after the two-week period, students were given a questionnaire designed to gage their attitude and experiences with polling systems. These surveys were done using the polling system with anonymous responses. No attempt was made to correlate reported experience with scores on homework or tests; rather the intent was to determine if students believed that using the response pads was of benefit to their learning.

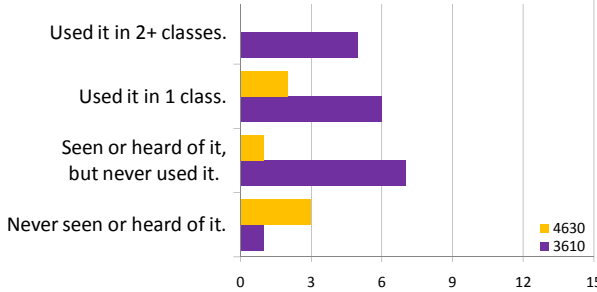
With most polling systems, there are two ways to implement questions – preplanned and verbal. Preplanned questions make use of system-specific software to develop a question bank, which is then accessed during class as needed. This method was used for the before and after surveys, but was not the typical in-class use. Verbal questions require no pre-planning, but rather allow the user to select a question type (multiple-choice, numeric, etc) and have students respond. In this study, the instructor did not change lecture plans from prior offerings, but at the points where students would normally be asked for an in-class response, a verbal question was used to solicit responses from the entire class. This resulted in 10-20 uses per class period in 3610 and 5-10 in 4630.

BEFORE QUESTIONNAIRE

The primary purpose of the before questionnaire was to gage past experiences with classroom polling systems. Both the Chemistry and Physics departments have been using polling systems for a few years, but with students progressing toward their degrees at different paces, and with the influx of transfer students, it was uncertain if all students would have past experiences with such systems. Figure 2 indicates the background experience of students in each class.

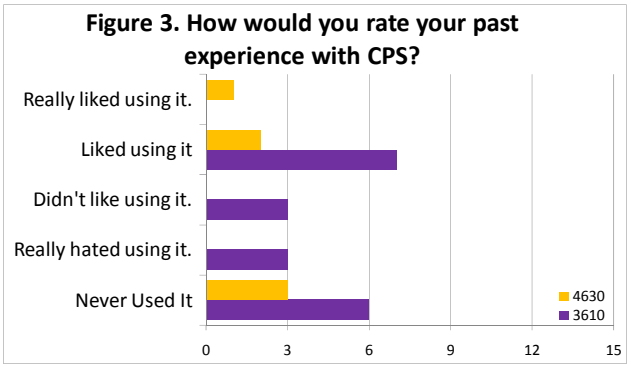
Because the adopted policy at TTU is to have students purchase their own response pads through the university bookstore for use in class, students were also asked about ownership. In 3610, about 40% of the students either owned or used to own their own pad, but none of the students in 4630 had ever owned the current pad.

Figure 2. What is your past experience with CPS?



Students were also asked to rate their past experiences with polling systems. As shown in

Figure 3, their experiences were clearly mixed. Anecdotal comments made it clear that the way each faculty member made use of the polling system may be the most significant factor in student reported experiences.



The before questionnaire concluded with the following three questions:

- How do you think CPS will affect your enjoyment of class?
- How do you think CPS will affect your level of participation class?
- How do you think CPS will affect your learning during class time?

In both classes, the response to all three of these questions was similar – about 80% of students in each class felt that they would get "more" out of class – more enjoyment, more participation, and more learning.

AFTER STUDY

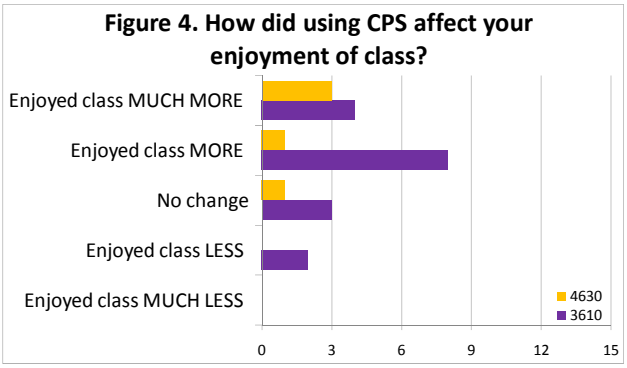
As noted above, the polling system was used in each class for approximately two weeks, after which a second survey was completed.

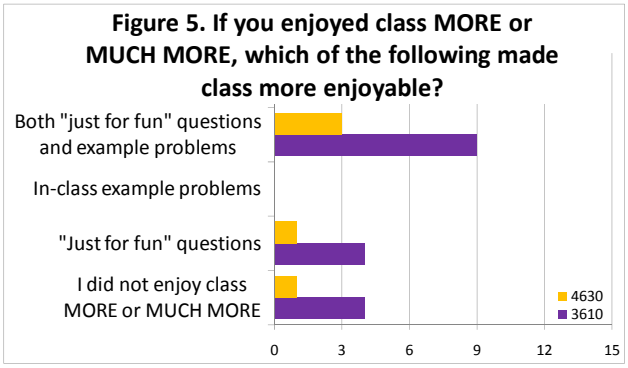
Enjoyment of Class

The first questions dealt with student enjoyment of class, with results are presented in Figures 4 and 5.

Figure 4 clearly shows a trend toward CPS making class more enjoyable. Figure 5 indicates that while more students thought the "just for fun" questions were added enjoyment, a significant number found additional enjoyment from in-class example problems. The "just for fun" questions took place at the beginning of class, and were primarily intended to ensure that each student had a working pad. Two example questions are:

- Who do you think will win the World Series?
- What is the fastest speed you have ever gone on the freeway?





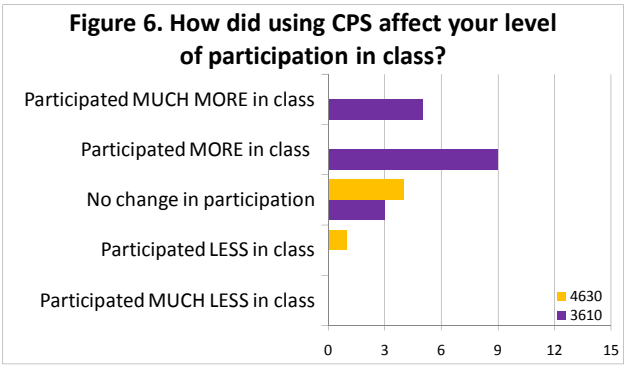
As noted above, the instructor made no changes in the example problems from the prior offering of the course. The difference was in the way these questions were implemented. In past semesters, the instructor would give the class an opportunity to work and example, and then ask for someone to volunteer the answer. With the response system, the instructor gave the class an opportunity to work the example problem and asked everyone to enter their response on the pad. The instructor typically waited for full participation unless excessive time was required.

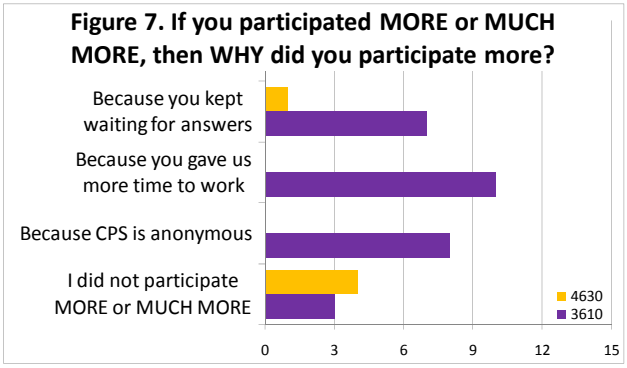
Level of Participation

The next group of questions was intended to determine student perception of their participation during class time. The results of these questions are shown in Figures 6 and 7.

If classroom participation is the goal of active learning, then the results presented in Figure 6 strongly indicate that using a polling system improved active learning in 3610. The results for that class are clearly indicating greater participation.

Figure 7 indicates that there are several reasons for this improved level of participation, with over half the students indicated that two or more of the reasons given were applicable to them. All three of the potential reasons provided received significant levels of response from students, which indicates that the use of polling systems may be able to improve the classroom experience for each student in a different way.





The results for 4630, however, are quite different. Most students felt there was no change in their participation, most likely due to the fact that a senior level elective with six students already has a high level of in-class participation by students.

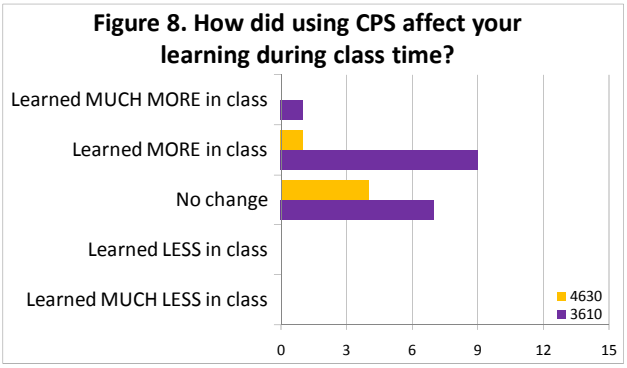
Learning during Class Time

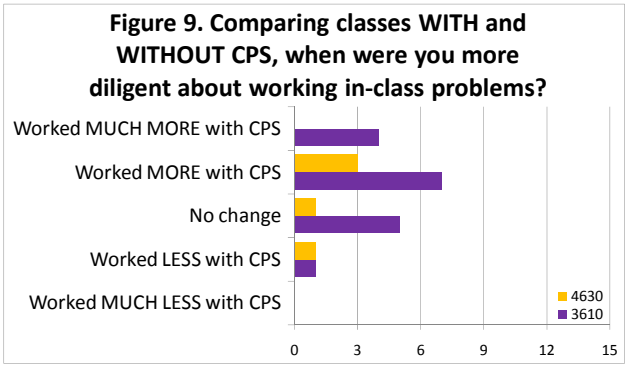
The next question dealt with student perception of their learning during class time, and its results are presented in Figure 8.

In both classes, a significant number of students reported no change. In 3610, however, there were also a significant number of students who reported an increase in their learning during class. While it is difficult to clearly identify those elements which would directly affect in-class learning, one of the key goals of active learning is to engage students during the class period. Since both these classes are lecture presentations with in-class examples, the primary opportunity to involve students is getting them to actively work on the example problems.

With this in mind, students were also asked to gage their diligence in working such problems, specifically in comparison to class periods earlier in the semester when they were not using the response pads. The results from this question are presented in Figure 9.

Based on their responses, students were clearly more diligent about working in-class example





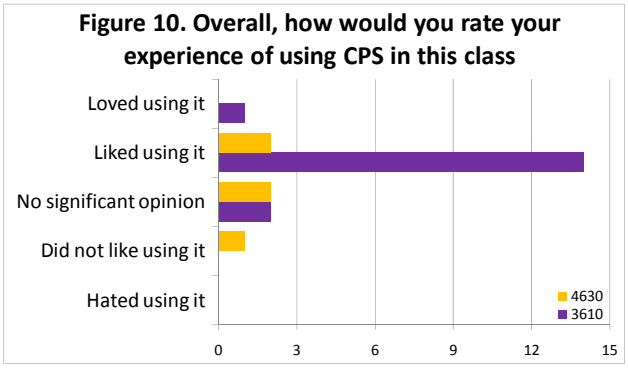
problems when using CPS. This likely goes back to the some of the same reasons discussed above, namely that students were given more time to work problems and that the instructor continued to wait until most students had entered a response on their pad.

Students were also asked if they felt that using a polling system in class had changed their outlook on either homework assignments or test performance. Both classes had two homework assignments on the topics covered while using the pads. The majority of students in both classes felt that there was no change in the apparent difficulty of homework.

Regarding tests, in 4630 the students had not been tested over the material covered while using the polling system. In 3610, the students had taken a test over the material covered while using the polling system, but had not yet received their grades on the test. In both classes, the overwhelming majority (≥80%) felt that there would be no difference in their test scores based on the use or non-use of a polling system while covering the material.

Overall Experience

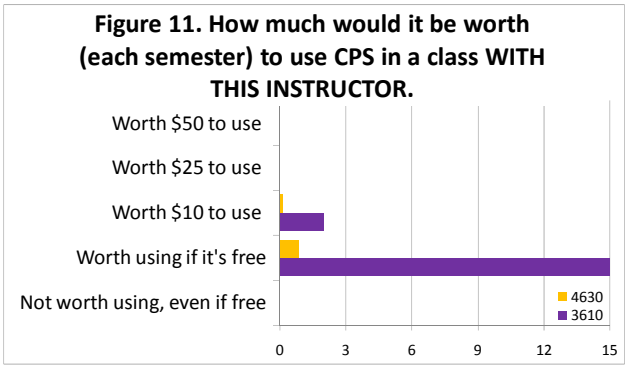
The final set of questions was intended to gage the overall experience students had when using the polling system. Their overall ratings are shown in Figure 10.



Given a positive classroom experience, which was clearly the case from these data, the question remains as to the overall value of using a polling system in the classroom? In an attempt to get a better indication of how much value that students would place on using such a system, they were asked if they would be willing to pay their own money for its use each semester.

Currently at TTU, students are expected to purchase their own response pad (~$25) and then need to either activate it for life (also ~$25) or activate it on a semester-by-semester basis (~$7 per semester). Pads are specified by course just like a textbook would be. There are a few classroom sets which are intended for training, but the university's intent is for students to purchase pads.

As shown in Figure 11, most of the students did not think there was enough benefit to justify an additional cost. Interestingly enough, many students commented that the university should use some of the current student fees to provide pads to everyone.



As noted earlier in the paper, during the before survey, there were indications that user experience was greatly impacted by the faculty member using the system. With this in mind, an additional question was asked to try and generalize the results to any instructor.

The results from the two classes varied significantly – in 3610, student opinion shifted to "not worth using even if free" while in 4630, student opinion shifted to "worth $10 to use." Discussions after the fact revealed a different interpretation of the question by the two classes. In 3610, the results were based on the general perception that other faculty would be less able to integrate the polling system into their classes. In 4630, the results were based on the general opinion that if more of the faculty

were using the system, the cost would essentially be distributed over several classes – so instead of thinking of the cost as $10 per semester, it would be more like $3 per class.

INSTRUCTOR COMMENTS

As the instructor, I found the experience of using a polling system very different between the two classes. In 4630, I found that the polling system often was more in the way than it was helpful. With only 6 students, the class always included a high level of participation from all students, so there was no apparent improvement in that area. Most of the in-class problems require 3-5 minutes for multi-step calculation, which significantly increased the chance that the responses would not show common results. There were, in fact, several occasions on which six different answers were given. All in all, I doubt I will use the polling system in 4630 again, unless the class size rises significantly.

In 3610, however, I found the polling system very beneficial. With 20 students in the class, it is difficult to provide enough opportunity for all students to be meaningfully engaged, and the use of the polling system clearly improved student participation. While its use did result in slowing down the pace of lectures somewhat, there was little difficulty in completing the planned material. As of now, I plan expanded use a polling system in 3610 in future offerings.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this paper was to present the results from a pilot study performed in two upper level transportation engineering courses at Tennessee Tech University (TTU). The study used before-and-after opinion surveys to gage student perceptions of classroom polling systems. About half of the students involved had used a classroom polling system before, and the average opinion about their benefits was neutral.

Based on the after study, students felt that using a classroom polling system increased both their enjoyment of class and their level of participation during class, and together these resulted in a slight increase in their learning during class. They reported that they were generally the same or more diligent in working class example problems, due to increased time available for problem solving and to the instructor waiting for them to provide input via the pad. Students also appreciated the fact that their responses were anonymous.

While the overall response was very positive, students indicated that they did not think it would be worth additional money each semester to use the response system in their classes. Anecdotally, the general feeling was that response pads should be provided to students from existing student fees.

Overall, classroom polling systems appear to provide at least some of the benefits claimed by their vendors, especially in larger classes where meaningful participation is more difficult. More research is clearly needed which would provide larger sample sizes and the opportunity to compare homework and test results between groups using and not using the polling systems. Also, more work is needed to determine if there is point at which the material becomes more complex than can be reasonably handled using a classroom polling system.

REFERENCES

[A] National Teaching and Learning Forum Website, accessed 2008-11-25.
http://www.ntlf.com/html/lib/bib/91-9dig.htm

[B] Center for Teaching, Learning, and Technology Website, accessed 2008-11-25.
http://www.cat.ilstu.edu/additional/tips/newActive.php

[C] eInstruction Web Site, accessed 2008-11-26
http://www.einstruction.com/Products/index.cfm