AC 2010-2086: USE OF CLICKERS FOR REAL-TIME ASSESSMENT IN AN INTRODUCTION TO THE CIVIL ENGINEERING PROFESSION COURSE

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Abstract

The objective of this paper is to show how clickers or Classroom Performance System (CPS) devices can be used to enhance the classroom experience and gain real-time assessment in an introductory civil engineering course. Clickers are currently being used in an introduction to the civil engineering profession course to engage students and assess what they have learned. For example, students use the clickers to identify historic civil engineering monuments as well as to differentiate various aspects within civil engineering subdisciplines. Results show that clickers do motivate students to be more attentive and help achieve the course objectives. Moreover, it was found that the clickers can also help teachers explain concepts better given the real-time feedback from the student responses.

Why Use Clickers?

The use of clickers or Classroom Performance System (CPS) devices is not a new application of technology. Previous studies have shown the effectiveness of the clicker technology to revealing concept retention and evaluating short-term retention.[1-3] However, the manner in which they can be used is vast and may be seemingly appropriate for some engineering courses to stimulate the learning environment and provide real-time assessment for both the students and instructor. Students can respond to multiple choice, yes/no, Likert scale, and true/false questions along with providing numeric responses and even responses to questions posed "on the fly" by the instructor. The CPS software enables the instructor to display the questions via CPS for PowerPoint or directly through the CPS software, which is quite user-friendly once a class roster has been uploaded. As such, clickers are an efficient means for engaging students, creating an active learning environment, and managing data for large class sizes.

Given their usefulness, clickers were deemed appropriate for first time use in a one (1) credit hour introduction to the civil engineering course that met on Fridays, where students were expected to achieve the following:

- Identify American Society of Civil Engineers (ASCE) monuments of the millennium
- Differentiate between the various subdisciplines within civil engineering
- Conclude which subdiscipline they would be interested in pursuing

It was found that students were more attentive during lectures when they knew that a response, and hopefully the correct response, would be required of them. Each lecture consisted of a speaker, typically a faculty member from a specific subdiscipline within the civil engineering department. (A schedule of the course topics is shown in Table 1). During the presentations, various aspects and challenges faced by those in the profession were emphasized along with research needs and career paths. During each lecture, the students were to respond to at least three (3) questions that were prepared by the speaker. Attendance was encouraged since students were to earn ten (10) points for attendance and one (1) point per clicker question for each class

presentation.   Although the difficulty of the questions would vary, most students attended class routinely and received full credit for both their attendance points and clicker responses. Students were allowed one "freebie" in the event of forgetting to bring his/her clicker or batteries failing, etc. To allot for this accommodation, the lowest points for one class period were dropped before the final grades were computed. The results from the grade distributions show that students still perform well despite the seemingly present pressure for students' grades to be based primarily on real-time assessments using the clickers. Therefore, it is believed that clickers help students pay more attention in class knowing that they will be immediately evaluated, which encourages students to take ownership of his/her learning.

Table 1: Course Topics for *Introduction to the Civil Engineering Profession*

Lecture	Date	Course Topics
1	September 4	Course Overview & Intro to CE Profession
2	September 11	Degree Plan & CE Monuments of the Millennium
3	September 18	Communication Skills
4	September 25	Materials and Infrastructure Engineering
5	October 2	Construction Engineering & Management
6	October 9	Transportation Engineering
7	October 16	Water Resources Engineering
8	October 23	Geotechnical Engineering
9	October 30	Environmental Engineering
10	November 6	Coastal and Ocean Engineering
11	November 13	Graduate School Panel
12	November 20	EIT & Professional Registration
--	November 27	Thanksgiving Holiday *(no class)*
13	December 4	Structural Engineering

Getting Started

The clickers, also referred to as CPS student response pads, used in this introduction to the civil engineering profession course were supplied through eInstruction.[4] To operate the system, a CPS radio frequency (RF) USB receiver unit (shown in Figure 1) is needed along with the software provided in the starter kit, which is of no cost to an institution. Unlimited training and technical support is available through eInstruction at http://einstruction.com/trainng. Requests were made to the University's bookstore to order the response pads that students were to purchase as required material for the course since no textbook was required. The response pad or clicker, also shown in Figure 1, cost approximately $25. Students had to register their clickers via eLearning (also known as Blackboard Vista), which corresponded to their University Identification Number (UIN). During the registration process, students are also required to pay a $13 registration fee per semester or a limit of $39.00 for lifetime usage to eInstruction. To troubleshoot, both instructor and student hotlines were available through eInstruction.

Figure 1: CPS response pad (pictured on left) and CPS USB receiver (pictured on right)

Real-time Assessment with Clickers

As stated earlier, students were posed with at least three (3) questions per class period related to the lecture. Sometimes the questions were disbursed throughout the lecture or at the end of the lecture. Using the CPS software allowed for student responses to be displayed immediately after polling to provide real-time assessment. Students would wait in anticipation of the final results to not only see how well they responded but to compare their responses to their classmates. Moreover, the data can be aggregated into response reports to show all data from the class period or all data filtered per student response for post-processing of the information. Three (3) examples of how clickers were used to engage students during presentations where there was a graduate school panel, lecture on environmental engineering, and lecture on EIT & Professional Registration. The results can be post-processed in many formats such as a response report, question report, and instructor summary, to name a few. Examples of a response report and question report from the fall 2009 semester for only one section (n=75), for brevity, are shown in Figures 2 through 4.

In Figure 2, the questions were mainly of a survey nature to gage information from the students regarding their interests in graduate school prior to the panel and then post-panel. There were a total of one (1) MS and three (3) Ph.D. students from the Department that served on the panel. The panelists first answered a slate of prepared questions by the author, and then there was an open forum for the students to ask specific questions of the panelists. Another survey question was posed in the lecture on environmental engineering for the faculty member to inquire how many students were interested in pursuing the environmental engineering track. The other questions posed during that lecture were based on the content delivered by the environmental engineering faculty member. On the response report, the correct answer is indicated by the finger pointed at the correct response. Students marveled at seeing the final results to not only see if they responded with the correct answer but to compare themselves to how their classmates responded. Moreover, seeing the student responses also help the instructor determine how well he/she conveyed particular concepts, and a chance for the instructor to reiterate a concept by providing more detail based on this real-time assessment. As such, the real-time assessment from clicker responses is an ideal measuring tool to assess teaching effectiveness and student

comprehension. An active environment where clickers are used promotes a positive learning environment that benefits students and instructors. The question report shown in Figure 4 displays the actual question and a bar chart of the response distribution. It was interesting to discover from the clicker responses that 25% of the students that responded did not know what was involved with obtaining a PE license. These results show that the course topics presented in this introductory course have relevancy and that students are learning more about what it means to become a civil engineer and what the civil engineering profession has to offer them so that they can contribute to society.

1	Are you thinking about going to grad school immediately after you graduate?		
	A	58%	Yes
	B	42%	No

2	After this discussion, have you changed your mind about going to grad school immediately after graduation?		
	A	42%	Yes, I am now considering going to grad school immediately after graduation
	B	14%	Yes, but not right away
	C	27%	No, I want to get work experience first and then go
	D	17%	Not at all interested in grad school

Figure 2: Response report of student responses from Lecture #11 – *Graduate School Panel*

1	Clicker Question #1:☐Environmental engineering is concerned with both human health and the health of the surrounding environment?		
☞	A	100%	True
	B	0%	False

2	Clicker Question #2:☐As an environmental engineering you can work on projects involving:		
	A	0%	Wastewater
	B	0%	Air Quality
	C	0%	Hazardous Waste/Site Remediation
	D	0%	Sustainable Systems
☞	E	100%	All of the above

3	Clicker Question #3:☐How many environmental engineering courses are offered at the undergraduate level?		
☞	A	100%	4
	B	0%	1
	C	0%	8

4	Clicker Question #4:☐Will you pursue the environmental engineering track within our department?		
	A	17%	Yes
	B	28%	No
	C	55%	I find environmental engineering interesting, but I'm not sure if I will pursue it

Figure 3: Response report of student responses from Lecture #9 – *Environmental Engineering*

1	Clicker Question/Survey:Are you planning on obtaining your PE license (Principles and Practice of Engineering)?

Answers
- A   Yes
- B   No
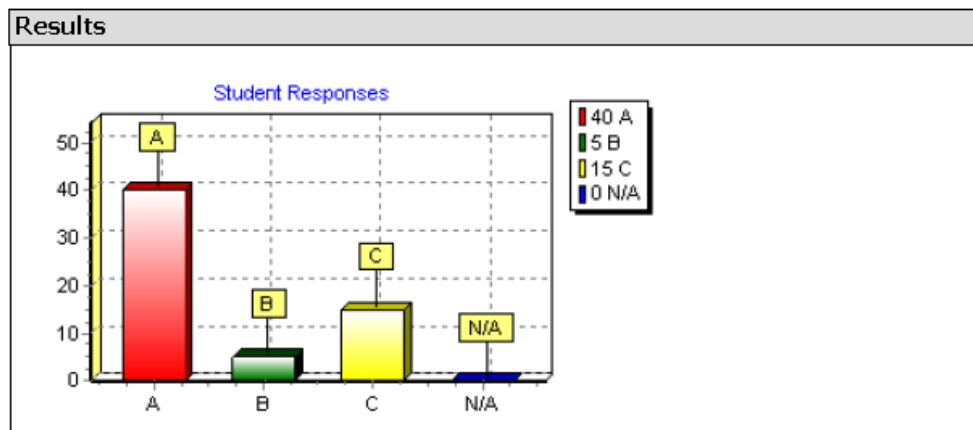- C   Not sure what it all entails.

Figure 4: Question report of student responses from Lecture #12 – *EIT & Professional Registration*

Effectiveness of Clickers for Real-time Assessment

Data was collected from the students' final grades over the course of the three (3) times the author taught this one (1) credit course. While the grading metrics changed when the clickers were used such that emphasis was placed on learning information during the class period, the distribution of the final grades revealed that student performance did not change dramatically (Figure 5). Prior to using the clickers, weekly quizzes were administered via paper on the previous week's lecture topic, where the students could review their notes and posted lecture notes online before taking the quiz. However, the author believes that it can be surmised that clickers help students pay more attention in class knowing that they will be immediately evaluated, which encourages students to take ownership of his/her learning. Table 2 shows the grade weights for how students will be evaluated for their final grade for the three (3) semesters the course was taught by the author. Note that another objective of the course was to help students refine their technical writing skills, where students had to write technical memos and business letters on various topics related to the civil engineering subdisciplines.

Table 2: Grading Evaluation for CVEN 207: *Introduction to the Civil Engineering Profession*

Semester	Writing assignments	In-class quizzes	CPS Clickers Used?
Fall 2007	80%	20%	No
Fall 2008	85%	15%	No
Fall 2009	20%	80%	Yes

The final distribution of grades from these semesters shows that clickers can be very effective for real-time assessment along with helping with data management for large classes. It does seem that for section 502, there was a larger percentage of B's during the fall 2009 semester with the clickers than in previous semesters without the clickers. Nonetheless, given a complete shift in focus for the grading metrics when clickers were used, there stills remains consistency within the grade distribution but with the added benefit of real-time assessment.
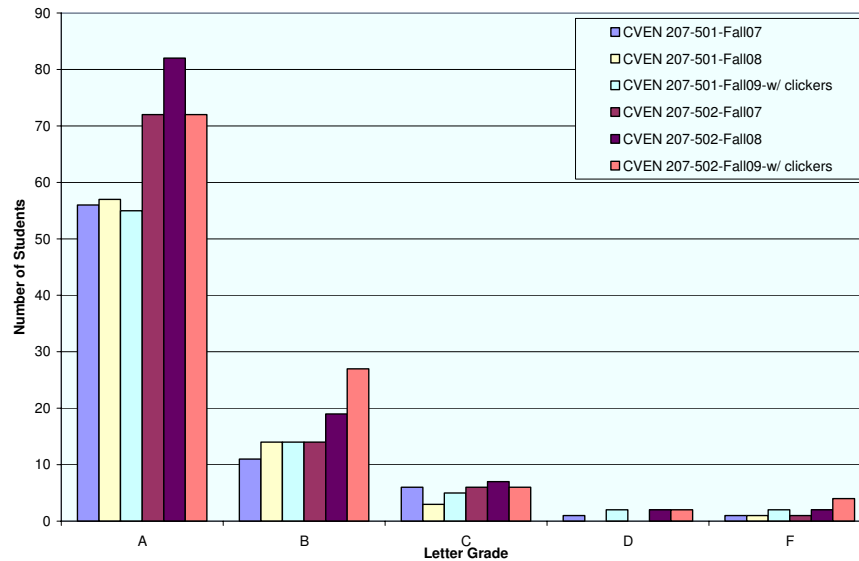

Figure 5: Letter Grade Distribution Without and With Clicker Usage

Conclusions and Suggestions for Future Use of Clickers

Using the clickers for the first time the aforementioned introduction to the civil engineering profession course proved to be beneficial to both students and presenters for ascertaining what students have learned and teaching effectiveness. Results show that the pressure for all students to respond in real-time did not inhibit their overall performance compared to years past when quizzes were administered a week later. During the fall 2009 semester, clicker questions were prepared in advance for the lecture, where students were expecting at least three (3) questions per lecture. One suggestion for future use would be to ask more questions extemporaneously to really engage students, thereby keeping them ready to respond in different modes allowed by the clickers. Providing variety is one of the unique benefits of using the clickers given the many options for which they can be used. Overall, more student engagement is believed to be a direct result of clicker use, which lends itself to having a more interactive and active learning environment. Furthermore, special attention should be given to surveying the students at the beginning and end of the semester to determine whether or not the subdisciplines they were interested remained the same or changed as a result of gaining more information from the class. Pre and post-tests on identification of civil engineering monuments are also planned in the future to show student achievement of the course objectives and long-term retention.

Bibliography

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