Workshop

Classroom Response Systems (CRS)

Gerry Gallagher & Brendan Ryder

Friday 13th May 2011
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Date(s): Friday 13th May 2011
Time: 12:00pm – 2:30pm
Location: P1106 (Carroll’s Building)

Aim

This purpose of this workshop is to examine how classroom response systems (CRS’s) can be used to facilitate the process of drawing out students’ prior knowledge, maintaining student attention and creating opportunities for meaningful engagement.

Content

The workshop will include coverage of the following:

- **Classroom Response System (CRS):**
  - What is an CRS?
  - How do CRS’s work?
  - CRS Uses

- **Technology Examples:**
  - eInstruction Clickers (IR version)
  - Poll Everywhere

Format

2.5-hour practical session.
Overview

• Classroom Response System (CRS):
  - What is a CRS?
  - How do CRS's work?
  - CRS Uses

• Technology Examples:
  - E-Instruction Clickers (IR version)
  - Poll Everywhere
What is a CRS?

- Any system used in a face-to-face setting to poll students and gather immediate feedback in response to questions posed by instructors/tutors/lecturers.
- Also called audience polling systems or clickers.

Example (non-technical):

- Instructor asking students to raise their hands to agree or disagree with a given question.

How do CRS’s work?

Ref:
Classroom Response Systems, Carnegie-Mellon Teaching with Technology Whitepaper:
http://www.cmu.edu/teaching/resources/PublicationsArchives/StudiesWhitepapers/ClassroomResponse_Nov07.pdf
CRS Uses

Monitoring the classroom
• Attendance tracking
• Completion of assigned readings

Audience-paced instruction
• Real-time evaluation of student comprehension

Peer instruction
• Question/Response cycle combined with discussion & debate among students

Technology Examples

- eInstruction
- Poll Everywhere
Demo

eInstruction
Simple Solutions. Real Results.

Demo

Poll Everywhere
Questions, Queries, Comments

Reference(s)

- Concepts:
  - Teaching with Classroom Response Systems: Creating Active Learning Environments, Jossey-Bass, 2009:
    - http://derekbruff.com/teachingwithcrs/
  - Classroom Response Systems, Carnegie-Mellon Teaching with Technology Whitepaper:
Reference(s)

• Technology Examples:
  
  o eInstruction clickers:
    ▪ http://www.einstruction.com/taxonomy/term/19
    ▪ CPS-IR - http://www.einstruction.com/node/66
  
  o Poll Everywhere:
    ▪ http://www.pollev everywhere.com/
    ▪ http://www.pollev everywhere.com/#video

Evaluation of Workshop

• Please take a few minutes to complete an evaluation survey for this workshop (available until 20/05/2011 at 5:00pm):

  https://www.surveymonkey.com/s/celtcrs
Thank You

- Thank you for your time and participation.

- Email: gerry.gallagher@dkit.ie / brendan.ryder@dkit.ie
How to foster meaningful engagement among students is a long-standing question in large lecture halls. In effort to address this issue, electronic classroom response systems (CRS) have been tested and used in higher education classrooms since the 1960’s.

The studies summarized in this paper show that CRS can facilitate the process of drawing out students’ prior knowledge, maintaining student attention, and creating opportunities for meaningful engagement. They can also assist instructors in assessing student comprehension and developing classroom activities that allow for the application of key concepts to practical problems.
There are three general categories of activities and equipment involved in using a classroom response system:

- **Instruction and questioning**
- **Response and display**
- **Data management and analysis**

A classroom response system (CRS) is any system used in a face-to-face setting to poll students and gather immediate feedback in response to questions posed by instructors. A non-technical example of a CRS is an instructor asking students to raise their hands to agree or disagree with a given question. A slightly more sophisticated practice involves the use of colored flashcards, with each color corresponding to a possible response in a multiple-choice question.

Over the past 30 years, technologists have developed and refined electronic response systems that allow students to key in responses using transmitters (also called “remotes” or “clickers”). The main advantages of electronic response systems over non-technical methods for gathering feedback are the anonymity of responses, and the ability to immediately project response graphs overhead for the class to see. Electronic response systems can also store response data for future analysis and assessment.

There are three categories of activities and equipment involved in using a classroom response system: presentation and questioning, student response and display, and data management and analysis.

**Instruction and questioning**

Software for most classroom response systems has been designed to integrate with common presentation software, like Microsoft PowerPoint. Some additional effort is required to develop question slides, but since many instructors already use presentation software (particularly instructors in large lecture courses, where the use of CRS is most appealing), the extra effort is minimized.

The kinds of questions posed by the instructor can range from simple factual recall to questions designed specifically to reveal and challenge common misconceptions in a given topic. Development of effective questions is crucial to the success of teaching with CRS, and is discussed in detail in a later section.

In class, the instructor presents concepts and materials, interspersed with slides asking for feedback from students. Questions are typically in true or false or multiple choice format. Question slides can be placed in line with regular lecture presentations so instructors can gather feedback on the fly, without switching applications during the presentation. Students are typically given a short period of time to key in responses.

**Response and display**

Students key in responses using small remote transmitters. These transmitters send signals to a receiver that is connected to the instructor’s laptop or lectern PC. Software on the instructor’s machine instantly tabulates and graphs student responses, and these simple graphs can be displayed on the following presentation slide. One of the more compelling aspects of using CRS is that students can compare their own responses to the responses of other students in the class, which can encourage a level of metacognition that might not otherwise occur.

Once students see the distribution of responses, many instructors take the opportunity to encourage discussion, asking students to reconsider the question in groups and to reach an agreement about the best response. Instructors often follow the discussion with a second cycle of questioning, response, and display before wrapping up the presentation of a given concept. This approach is often referred to as “peer instruction.”

**Data management and analysis**

Most classroom response systems allow instructors to export and save response data for future analysis and assessment. Some systems also integrate with course management systems, like Blackboard. This integration allows instructors to save and track student responses over the course of the semester, and simplifies the assessment process.
Instructor presents concepts and materials, interspersed with slides asking for feedback from students. Questions are typically in true or false or multiple choice format.

Students key in their responses using small remote transmitters. These transmitters send signals to a receiver that is connected to the instructor’s laptop or lectern PC.

Many instructors then ask students to discuss the responses in groups, and to reach an agreement about the best response. This discussion can be followed with a second cycle of questioning, response, and display.

Software on the instructor’s machine instantly tabulates and graphs student responses, and these simple graphs can be displayed on the following presentation slide.

Most classroom response systems allow instructors to export and save response data for future analysis and evaluation. Some systems also integrate with course management systems, like Blackboard, to simplify the assessment process.
Most strategies for using CRS fall into one of three general categories of implementation:

**Monitoring the classroom**
- Attendance, attention, completion of assigned readings

**Audience-paced instruction**
- Real-time evaluation of student comprehension

**Peer instruction**
- Question/response cycle combined with discussion and debate among students

High-enrollment courses present challenges to many basic principles and established best practices in teaching and learning. Instructors in large lecture courses often face difficulty drawing out prior knowledge or misconceptions, motivating students and maintaining their attention, creating opportunities for meaningful engagement, assessing student comprehension, and developing classroom activities that allow for the application of key concepts to practical problems. Yet high-enrollment lectures remain the norm for introductory courses in many disciplines, and instructors have long sought tools and teaching strategies to help overcome these challenges.

For over 40 years, electronic classroom response systems have been investigated as a potential bridge for the communication gap between lecturers and students. Early systems were hard-wired into classrooms, with an input device at each seat in a lecture hall. These systems were costly and difficult to use, given the lack of graphical user interface and the complexity of software for data manipulation and display.

Improvements to hardware and software solutions and vast changes to the technology landscape have created a resurgent interest in CRS in the past decade. New systems are much more affordable, often portable, and take advantage of other technologies already in use in most large lecture halls (i.e., presentation software, lectern hardware, and projection systems).

There are essentially three levels of implementation of classroom response systems, each with progressively more change in pedagogical approach, and—as best we can determine through an examination of the relevant literature—increasing improvement in terms of learning outcomes.

At the most basic level of implementation, classroom response systems serve as means for the instructor to monitor the classroom. The instructor uses CRS to take attendance, to ensure some level of participation, and to increase the students’ level of attention during the lecture. The instructor might also ask very basic questions about reading assignments as a means to verify whether students completed the reading. In this scenario, the instructor uses CRS as a way to encourage attendance and some basic level of attention and participation, but makes very few intentional changes to the sequence, delivery, or duration of lecturing on a given concept.

At the second level of implementation, the instructor uses CRS to gather real-time information about student comprehension of a given concept. From the responses, the instructor is able to determine whether she should spend more time explaining an idea, or if the majority of the class understands the idea, allowing her to move on to the next topic. The students help set the pace of instruction with clear indication of their comprehension or confusion.

The third approach to teaching with classroom response often involves a transformation in the instructor’s teaching philosophy and strategies. This approach involves interspersing the presentation of concepts with question and response cycles, followed by periods of discussion where students defend their responses and try to persuade classmates with their reasoning. Discussions are typically wrapped up with another question and response cycle where students can indicate their new response to the same question.

**Monitoring the Classroom**

The motivation to use classroom response systems most commonly derives from a desire to stimulate student engagement. Instructors in large lecture halls often struggle against what Rand Guthrie and Anna Carlin call “the sea of slouching bodies and expressionless faces” (2004). Efforts to engage students with questions yield few volunteers, and instructors often...
cannot determine where their lectures succeed or fail until examination time.

Even at the most basic level of implementation, where the instructor makes very few intentional changes to the lecture strategy, it seems that the use of classroom response systems can contribute to an instructor’s participation and attendance goals.

Certainly, attendance policies can be much harder to enforce in high-enrollment courses than in smaller courses. In an introductory Earth Science course at Penn State University, the instructor used CRS responses over the course of the semester as 15% of the final course grade (Greer and Heaney, 2004). Whether responses were correct or not was not a factor, only whether students participated. Mean attendance ranged from 81% to 84% over the four CRS semesters measured, compared to an estimated 50% by the midpoint of semesters without CRS. Head counts were also conducted to account for “the possibility that absent students had handed their remote control units to friends who entered responses on their behalf.” Discrepancies between CRS attendance numbers and the results of head counts were typically +/- 2% (p. 348).

Although the comparison numbers are estimates, not directly measured in a controlled setting, many other CRS studies report similar findings. Judson and Sawada conducted an extensive literature review on response systems, and report that research “from the 1960s through the late 1990s found that the use of electronic response systems made students more likely to attend class” (2002, p. 177).

Classroom response systems have been evaluated in several studies conducted in the context of continuing medical education (CME) lectures and seminars. Survey results from these and other studies indicate that student satisfaction increases in lectures using CRS (or ARS, audience response systems). Further, students report believing that the use of CRS has a positive impact on their performance.

Miller et. al. (2003) conducted a randomized controlled trial of audience response systems at 42 clinical round table programs across the country, and surveyed nearly 300 participants about their experience in ARS and non-ARS lectures.

Results showed that “participants who attended ARS lectures rated the quality of the talk, the speaker, and their level of attention significantly higher than the non-ARS group” (p. 112). While analysis did show that the differences between the two groups were statistically valid, the mean differences did not diverge to the degree that might be expected. Presentation quality was rated at a mean of 3.9 on a scale of 5 for non-ARS, and 4.0 for non-ARS. Speaker quality was rated 3.9 for non-ARS and 4.1 for ARS, while “ability of presentation to maintain attention and interest” was rated 4.2 for non-ARS, and 4.4 for ARS (p. 113).

The survey instrument in Miller’s study also included a handful of questions assessing participants’ understanding of the material presented, and results showed no significant difference in learning outcomes in ARS and non-ARS classes. The researchers theorize that the types of follow-up questions posed might not address differences in “long-term retention and application of knowledge” (p. 113).

In a separate study of CME lectures covering multiple years of classes offered with and without audience response systems, Copeland et. al. found that “lectures in which the ARS was used were significantly better rated than those in which the ARS was not used” (1998, p. 231). Over three years, mean ratings for lectures with ARS were about 3.47 on a scale of 1 to 4, compared to non-ARS lectures rated as 3.32. Even more telling, however, was a comparison of ratings from multiple lectures from a single speaker, two delivered with audience response, and one without. In the lectures delivered without audience

“As we gaze out at the sea of slouching bodies and expressionless faces, it is hard to resist wondering if students want less education and more entertainment.”
Rand W. Guthrie and Anna Carlin
response, the speaker received an average rating of 3.09 on a scale of 1 to 4. In a lecture delivered with audience response, the same speaker was rated at 3.74 (p. 232).

Another form of classroom monitoring with CRS is to present short quizzes at the beginning or end of a lecture period. Quizzes might cover homework or reading assignments, or basic concepts from the material covered in the previous or current lecture. In the Fall of 2004, Richard Hall and others at the University of Missouri, Rolla, conducted a pilot evaluation of classroom response systems in a General Chemistry course (2005). They opened each lecture with a brief quiz about the assigned readings, and found that the quizzes “served as a powerful motivator not just for attendance, but class preparation as well” (p. 5). Students reported that the quizzes helped them “learn what the professor was wanting us to get out of the reading,” and that “you can see the areas you need to go back and look at when you get questions wrong” (p. 5).

In the same study, student responses to open-ended survey questions verified that interspersing lectures with CRS question/response cycles facilitates some level of increased engagement and metacognition. Students indicated that CRS “helped you pay attention in class because you knew you had a question coming,” and that “it’s a good way to know if you understand the material” (p. 5).

Evidence from these and other studies indicates that the use of CRS in the classroom, even at a basic level, can increase attendance rates, bring problem areas to the surface, and increase student satisfaction with lectures.

**Audience-Paced Instruction**

Once instructors can see plainly what students do and do not understand, the intuitive next step is to adjust the pace of presentation and explanation strategies accordingly. The second level of CRS implementation is a very natural extension of the first.

The previously discussed CRS pilot at the University of Missouri was in many ways a combination of all three levels of using CRS. In addition to quizzes on reading assignments and question cycles throughout lecture (classroom monitoring), the lectures were modified “based on student understanding as represented by the accuracy of their responses” (Hall et. al., 2005, p.3). This modification is the essence of audience-paced instruction. Students were also often allowed to discuss the questions with classmates before responding during the lecture. It is difficult to characterize this study as distinctly one type of CRS implementation. However, because the main focus of the study is on using CRS to increase engagement and assess comprehension in order to customize lecture presentation, we present and discuss their results primarily as classroom monitoring and audience-paced instruction.

Upon completion of the CRS pilot course in Hall’s study, students were surveyed regarding their perceptions of the usefulness of CRS. Most students agreed that CRS made class lectures more engaging (87%), and enhanced their learning in class lectures (73%). A smaller majority also agreed that CRS “made the lectures more motivational” (63%). Students were divided as to whether CRS made class more challenging, and most disagreed (63%) that CRS helped them better understand how course material related to “real world” problems (p. 4).

Hall’s research group compared the grade distribution for the semester with classroom response to a previous semester without CRS. While they acknowledge a lack of specific control measures to assure consistent grading standards and to account for student ability across semesters, they report that “grades were
The percentage of students earning A’s increased from 23% to 40%, and the percentage of students receiving C’s or D’s in the course decreased from 34% to 21% (p. 4).

The Penn State University study discussed in the classroom monitoring section also employed audience-paced feedback methods to “encourage active student participation” and allow “both students and instructors to gauge student comprehension instantaneously” (p. 345).

Multiple instructors involved in this study, teaching various sections of an introductory science course. Although instructors “shared the same course syllabus, lecture outline, course structure, and grading scheme throughout each semester,” they also developed their own questions and maintained their “own classroom ‘style’ during the semester” (p. 347). From the description of their CRS implementation, it seems again that their approach can not be described exclusively as classroom monitoring, audience-paced feedback, or peer instruction. However, at a minimum instructors used CRS for real-time assessment of student understanding, and to directly address misconceptions that were revealed through questioning.

Qualitative feedback offered in course evaluations emphasize that students appreciate the anonymity of CRS (“it gave shy kids the chance to participate,” “I don’t feel put on the spot”); that CRS encourages attendance (“gave you an incentive to go to class,” “forces me to come to class”); and that CRS facilitates more engagement throughout the lecture (“helped everyone get involved in such a large class,” “lets me see if I am understanding the lecture or not and it truly does give a nice break from straight lecturing”). Negative comments included frustration with attendance monitoring (“extremely expensive way to take attendance,” “dislike the way the teacher uses the system”); cost (“one of the most expensive classes I have ever taken,” “overrated and expensive”); and speculation that question and response cycles are not the most effective use of class time (“takes up class time when she should be lecturing”) (p. 349).

Although students can be resistant to any additional expenses associated with classroom response systems, many instructors equate the cost of the transmitter to the purchase of a textbook. Transmitters range in price from about $20 for basic infrared systems to $125 for the higher-end radio frequency systems. Transmitters can also be sold at the end of a semester to help offset the cost. For more information on differences in available systems, see the Appendix.

Researchers at Eindhoven University compared survey and performance data for 2,500 students in course sections delivered with audience-paced instruction to equivalent data from 2,800 students in sections delivered in the traditional lecture format (Poulis et al., 1998). This study showed that the mean pass rate for audience-paced instruction lectures “is significantly higher than where traditional methods have been employed” (p. 441). The mean pass rate for traditional sections was less than 60%, while for audience-paced instruction sections, it was over 80%.

Students were asked at the midpoint of the semester to participate in a brief anonymous survey to share their impressions on the effectiveness of CRS. A majority of students (65-77%) agreed that the use of CRS helped them gauge their understanding of course material, and 71-85% agreed that it reinforced important concepts presented in the lecture. Between 65% and 81% of students surveyed believed that the use of CRS in lecture helped them learn (p. 348-349).
experimental environment, is a more convincing measure than students’ self-reported behavior and perceptions of the effectiveness of CRS or audience-paced instruction. What students believe and report to believe about their learning and behavior can differ significantly from what they actually do and learn. Taken together, the findings from the studies cited shed some light on the potential impact of using CRS to gauge student comprehension in order to tailor the lecture delivery.

**Peer Instruction**

In this approach to teaching with CRS, the lecture process shifts from the “ballistic” model of knowledge transfer (plan and launch a lecture at the students, check later to see if you hit the target) to a more constructivist model, with the student actively building knowledge as a result of meaningful classroom interactions and activities.

Peer instruction (PI) was pioneered and has been evaluated extensively by Eric Mazur and others in the Department of Physics at Harvard University. Mazur and his colleague, Catherine Crouch, define peer instruction as the modification of “the traditional lecture format to include questions designed to engage students and uncover difficulties with the material” (2001, p. 970). They continue:

“A class taught with PI is divided into a series of short presentations, each focused on a central point and followed by a related conceptual question.... Students are given one or two minutes to formulate individual answers and report their answers to the instructor. Students then discuss their answers with others sitting around them; the instructor urges students to try to convince each other of the correctness of their own answer by explaining the underlying reasoning. During the discussion, which typically lasts two to four minutes, the instructor moves around the room listening. Finally, the instructor calls an end to the discussion, polls students for their answers again (which may have changed based on the discussion), explains the answer, and moves on to the next topic” (p. 970).

These discussion periods help students understand the key concepts behind their answers, and facilitate a deeper, more practical comprehension than what might result from a traditional lecture. While electronic response systems are not essential to peer instruction, they certainly facilitate the process more efficiently and capture data more effectively than other methods of gathering feedback (polling by use of colored flash cards or show of hands).

There are many articles documenting the effectiveness of peer instruction (also described as “interactive engagement”) in various settings. In one such assessment, Mazur and Crouch report on ten years of findings from physics courses at Harvard (2001). They analyze learning outcomes in terms of conceptual mastery, using test results from the Force Concept Inventory (FCI), and quantitative problem solving, using data from the Mechanics Baseline Test (MBT). (The FCI and MBT are standard assessments of student performance in physics. They are administered nationally as pre- and post-tests to evaluate and compare student learning in physics.)

The average normalized gain from pre- and post-test FCI doubled in the first year of implementing peer instruction in a calculus-based physics course. Furthermore, as the instructors refined their use of peer instruction and the choice of discussion questions (called “ConcepTests”), FCI results continued to improve (p. 971).

The average normalized gain doubled in the first year of implementing peer instruction, and continued to grow each year as teaching methods were refined.

In 1990, the last year of traditional instruction, the FCI normalized gain was approximately 0.23. In 1991, the gain was 0.49, and that number increased every year until 1997, when it had reached 0.74. In 1998, they switched to algebra-based introductory physics, but FCI gains remained high at 0.65. In 1999, the course reverted to the traditional lec-
ture format, and gains dropped again to 0.40. The following year, peer instruction was implemented again and the gain rose to 0.63 (p. 971).

In the peer instruction courses, traditional problem solving is de-emphasized and students are required to learn and practice these skills “primarily through discussion sections and homework assignments” (p. 971). Nonetheless, students in PI classes fared better than traditionally taught cohorts on the MBT, a widely accepted assessment of physics problem-solving skills. The average score on the MBT increased “from 66% in 1990 with traditional instruction to 72% in 1991 with the introduction of PI” (p. 971). As with the FCI, student performance continued to rise as instructors refined the approach, reaching 79% in 1997. In another comparative problem-solving examination, the mean score increased from 63% with traditional instruction to 69% with peer instruction, and there were also “fewer extremely low scores” in the peer instruction group (p. 971).

In an analysis of all ConcepTest responses over the course of a semester, Crouch and Mazur found that, on average, 40% of students answered correctly both before and after peer discussion. Some 32% of students answered incorrectly at first but correctly after the discussion, while 22% of students answered incorrectly twice. Only 6% answered correctly first then changed to the incorrect answer after discussion. They also found that “no student gave the correct answer to the ConcepTests prior to discussion more than 80% of the time, indicating that even the strongest students are challenged by the ConcepTests” (p. 973).

The outcomes in the Department of Physics at Harvard are certainly convincing in terms of improved learning outcomes with peer instruction, and several other large-scale studies serve to corroborate these findings. In a variant approach to peer instruction, professors at Iowa State University attempt to achieve “virtually continuous instructor-student interaction through a ‘fully interactive’ physics lecture” (Meltzer and Manivannan, 2002, p. 639). Again, the use of CRS is not critical to the teaching approach, but serves to support and facilitate the methods employed.

Comparing results from students in the fully interactive ISU courses to national results on the Conceptual Survey in Electricity and Magnetism shows even greater leaps in learning than those found at Harvard. The normalized pre- and post-test gains for interactive lectures was “triple those found in the national survey,” which presumably consists of a sample of students primarily in traditional lecture classes. Normalized gains for ISU interactive courses were 0.68, compared to 0.22 in the national sample (p. 648).

And finally, Richard Hake conducted an analysis of 6,000 students’ results on two national physics assessments, the Force Concept Inventory and the Mechanics Baseline Test (1998). By gathering and analyzing additional data on the type of instruction offered in these students’ courses, Hake found that the 14 traditionally taught courses had an average normalized gain of 0.23±0.04. By contrast, the 48 courses that used interactive engagement methods like those outlined in the previous two studies showed an average normalized gain of 0.48±0.14 (p. 71).

These studies confirm that teaching methods that encourage active and meaningful participation and engagement on the part of the student can radically transform the nature and scope of learning that takes place. While CRS was not a central component of any of these evaluations, many instructors have found that the use of CRS can simplify and streamline information gathering and display in the interactive lecture hall.
Classroom response systems can bridge the communication gap between instructor and students, and facilitate high-engagement lectures.

This report is intended to serve as an overview of classroom response systems, and a summary of findings from formal evaluations of various implementation scenarios.

Audience-paced and peer instruction can have a greater impact on learning outcomes, but also require a greater degree of deviation from the traditional lecture approach.

These studies show that classroom response systems can facilitate the process of drawing out prior knowledge, maintaining student attention, and creating opportunities for meaningful engagement. They can also assist instructors in assessing student comprehension and developing classroom activities that allow for the application of key concepts to practical problems. As with other educational technologies, the most successful implementations occur when instructors set clear educational goals, and facilitate the achievement of those goals through thoughtful, engaging learning activities.

Each of the three levels of implementation discussed—classroom monitoring, audience-paced instruction, and peer instruction—can have a positive impact on the learning experience and educational outcomes when thoughtfully deployed. Audience-paced and peer instruction show the most potential for impact in terms of learning outcomes, but also require a greater degree of deviation from the traditional lecture approach.

Support

If you are an instructor at Carnegie Mellon and are interested in discussing the use of classroom response systems in your class, please contact the:
Office of Technology for Education
te@andrew.cmu.edu
412-268-5503

Our consultants will be happy to assist you with any phase of planning, designing, implementing, funding, and evaluating the use of technology tools and strategies for teaching.

References


References (continued)


The most predominant sales model for classroom response systems is for a single company to provide all necessary hardware and software for the system. (The most common exception is when the product is a software-only solution, designed for use on existing wi-fi or wired networks. Such solutions are discussed in more detail in the next section.)

In many cases, software and receivers are provided at little or no cost, with most profit resulting from the sales of student transmitters. Many universities choose to pass along the full or partial cost of transmitters to the students, especially where systems are widely adopted and students can expect to use a single transmitter in multiple classes.

**TurningPoint.** from Turning Technologies, is one of the most versatile solutions on the market. Their software integrates completely into Microsoft PowerPoint, allowing professors to author, deliver, assess, and report from within PowerPoint. TurningPoint offers infrared and radio frequency versions of their student transmitters, and simple USB-based receivers. Virtual Keypad (or vPad) is available for wireless classrooms as a software alternative to transmitters and receivers.

**InterWrite** also offers both infrared and radio frequency transmitters. Unlike most transmitters on the market, both the IR and RF transmitters offer high and low “confidence level” keys, allowing students to indicate how confident they are in their answers. The RF transmitter screen can display 16 characters—more text on screen at once than most other systems. This allows for a self-paced testing functionality, where students can scroll through a series of questions and answer at their own pace.

**eInstruction** offers a basic, inexpensive classroom response system. Although the software was designed to be used easily with presentation software like PowerPoint, there is currently no direct integration between these applications. Similarly, while most systems integrate fairly directly with Blackboard, file manipulation is required to use eInstruction PRS data in Blackboard’s gradebooks. The transmitters are fairly inexpensive to purchase, but require the purchase of a new activation code each semester. Activation currently costs $12 to $18.
H-ITT boasts the lowest system cost on the market. It offers only infrared transmitters, but its receivers have a wider pick-up range than most other infrared systems (a 180-degree cone, compared to 90 degrees on other systems). H-ITT comes with two separate software packages: one is used in class to collect and view responses, and the other is used to manage and grade responses over the course of the semester. Each remote costs about $25, and there are no activation fees. The receiver costs about $200, and one receiver must be purchased for every 50 remotes.

Qwizdom places heavy emphasis on the physical design of their transmitters. The large text display on both instructor and student remotes allows for one-to-one communication, a feature not supported on any other system reviewed here. Receivers and software are free, but the remotes cost about $100 apiece. The price is high compared to other transmitters, but they are intended to be purchased once and used for the duration of a student’s college career.

TI-Navigator, from Texas Instruments, uses radio-frequency hubs to connect student’s calculators to the teacher’s PC. The system seems to focus most heavily on mathematics applications for obvious reasons, but it is unclear as to whether the calculators can be used for more general questions and polling. The system is fairly costly, pricing at around $4000 (not including calculators) for a 32-student classroom. Its advantages over other classroom response systems are specific to math applications.

Many classroom response systems are being developed solely as software applications that are designed to run over Wi-Fi on existing portable devices, like laptops and Pocket PCs. Numina II is a browser-based application developed at the University of North Carolina, Wilmington. Class in Hand is software for the Pocket PC that was developed at Wake Forest University. Both of these applications are currently free to use. For those who are more comfortable with the accountability and support of a retail product, ETS Discourse is the commercial equivalent.
Infrared, radio frequency, and Wi-Fi systems each have advantages and disadvantages, and deciding which system is best depends heavily upon the needs and priorities for a given context.

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<thead>
<tr>
<th>System</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Infrared</td>
<td>Infrared (IR) systems basically use the same line-of-sight technology that is used in household television remotes.</td>
<td>Most IR systems often offer only one-way communication, which does not allow for confirmation when student’s response has been received.</td>
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<td>They have the lowest overall equipment cost.</td>
<td>They also require the placement of receivers in line-of-sight of students, which often means permanent or semi-permanent installation.</td>
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<td>There are no interference issues from classroom to classroom, as signals do not go beyond the walls of the room.</td>
<td>Each receiver can only support between 40 and 80 transmitters (depending on manufacturer), so multiple receivers are necessary for larger classes.</td>
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<td>Because the clickers must be aimed directly at the receivers in order to work (and thus have high visibility in the classroom), they also reduce the likelihood that students will bring in each other’s transmitters when responses are used for attendance or participation grades.</td>
<td>In very large classes, signal reception can be unreliable and have a shorter range.</td>
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<tr>
<td>Radio Frequency</td>
<td>In radio frequency (RF) systems, the receiver does not have to be placed in line-of-sight of students, allowing for increased portability in hardware solutions.</td>
<td>Low visibility might make it easier for students to cheat the system by bringing in each other’s transmitters when responses are used for attendance or participation grades.</td>
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<tr>
<td></td>
<td>Signal reception is more reliable and has a longer range.</td>
<td>RF clickers are more expensive than IR.</td>
</tr>
<tr>
<td></td>
<td>RF systems also allow for two-way communication, so clickers can confirm when student’s response has been received.</td>
<td>There is a higher likelihood of interference issues as RF clickers can operate on the same frequencies as Wi-Fi and other RF devices.</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Wi-Fi systems use a web-based interface for student interaction. These systems allow for text entry and open-ended responses.</td>
<td>Requires students to have a Wi-Fi computing device.</td>
</tr>
<tr>
<td></td>
<td>Students can use a wide variety of Wi-Fi devices.</td>
<td>Fewer choices currently available in the marketplace.</td>
</tr>
<tr>
<td></td>
<td>Uses the existing campus wireless infrastructure.</td>
<td></td>
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</tbody>
</table>

Adapted from the University of Minnesota Office of Classroom Management’s “Student Response Systems Overview”
http://www.classroom.umn.edu/notes/support_srs.asp
Many faculty are teaching fully online courses though a combination of social media and LMS systems. For instance, Michelle Pacansky-Brock uses Moodle to manage assignments and maintain her gradebook, and Ning to teach her class. Steve Kolowich uses Moodle plus Skype and Elluminate to add interactive elements to his online courses. At Norwich University, I’ve added blogs, wikis and webinars outside of our LMS to provide students with an opportunity to explore issues within the profession that interests them.

Schools are starting to attach social media “shells” to their LMS. GoingOn provides blogs and other forms of discussion that exist outside of the classroom to allow collaboration between students across the institution. For instance, all students in a business program can carry on discussions related to business outside of their particular courses. Learning Objects is another system that provides students with a “personal learning space” where they can create a blog, share sites, and collaborate in a variety of ways with like-minded students. It also allows clubs and departments to create Facebook-like sites to share information.

Schools are changing to an LMS built on social media principles, such as Drupal. An open source platform, Drupal gives faculty the flexibility to make student blogs the homepage of their course, rather than administrative functions, encouraging collaboration. Better yet, any part of a course can be made public so that students can engage in conversations with other students, faculty, or professionals in the field.

Education is changing, and social media is presenting a world of opportunity to improve learning outcomes.

John Orlando, PhD, is the program director for the online Master of Science in Business Continuity Management and Master of Science in Information Assurance programs at Norwich University. John develops faculty training in online education and is available for consulting at jorlando@norwich.edu.

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Using Polling and Smartphones to Keep Students Engaged

By John Orlando, PhD

It’s an age-old problem. You want to make the most of every minute you have with your students, but it’s been proven that most people can only retain about 20 minutes of content in our short-term memory before we have to reflect on it in order to move it to our long-term memory or it will be lost. Add to this the violently condensed attention span of the general population and anyone hoping to provide a content-rich education in the time slots of traditional classes faces an uphill battle.

Polling provides an ideal way to both keep a class’ attention and provide a reflective activity to move information into long-term memory. Plus, it’s remarkably easy. Free websites allow you to set up polls that students take by submitting their answers via text message or on the Web. These polls are a wonderful way to engage students in the material and keep their interest. Best of all, the results appear in real time so students can see changes as they come in.

One good use of polls is to gather information about a subject before it is covered. This is especially helpful when the subject concerns information that students might not want to make public with a show of hands. For instance, a teacher could introduce a discussion of cheating on exams.

Resources

Insidious Pedagogy: How Course Management Systems Impact Teaching [link].

Learning Management Technologies: Enterprise Systems or Consumer Goods? [link].

Envisioning the Post-LMS Era: The Open Learning Network [link].

The Traditional LMS is Dead: Looking to a Modularized Future [link].

Drupal: [http://drupal.org/](http://drupal.org/)


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by asking students in a large lecture to indicate if they have ever cheated on an exam. This could be used to demonstrate that cheating is more common than people think. A science instructor can ask students to guess the results of an experiment before it is conducted to generate thought and interest in the outcome. Forcing students to take a position not only creates reflection, but also commitment to results. Everyone wants their position affirmed.

Another option is to ask students for their opinions and use the results as a way of initiating a discussion on the issue. Or you could ask a simple factual question that you know most people will get wrong in order to demonstrate a widespread misconception.

Polls also can be used after content is presented as a means of generating reflection on the issue. These can be simple factual questions that demonstrate whether the students understood the material, or higher level questions that will help them to retain the material.

Using smartphones to conduct polls

While many instructors consider smartphones the bane of teaching—causing distraction and even cheating during a test—polling turns the technology into a teacher’s advantage by engaging students with the content.

In this screencast, I demonstrate how easy it is to use polling software. Watch it here »

Links

Poll Everywhere (http://www.polleverywhere.com)
Unlimited polls with up to 30 respondents on the free plan.

Flisti (http://flisti.com)
Super easy polling system. No signup required.

MicroPoll (http://www.micropoll.com)
Good for creating a poll to embed in a blog or some other website.

Vorbeo (http://vorbeo.com)
Another system for creating a poll to embed in your website.

PollDaddy (http://www.poll Daddy.com)
Free and paid plans available.

TextTheMob (http://textthemob.com)
Free plan allows for up to three questions with 50 responses.

FROM PAGE 11

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Lecture Capture: A New Way to Think about Hybrid Courses

By John Orlando, PhD

“Hybrid education” has become a hot catchphrase recently as faculty blend face-to-face learning with online technology. But the growth of hybrid education has been steered by the unstated assumption that hybrid technology should be used to facilitate discussion outside of the classroom, while classroom time should be spent lecturing.

Now José Bowen, dean of the Meadows School of the Arts at Southern Methodist University, challenges this assumption by asking his faculty to put their lectures online and devote face-to-face classes to discussion. His logic is impeccable. Lecturing is simply delivering delivery, and not much different from reading a textbook in this regard. If so, then why must lectures be held in class? An instructor could just as easily record his or her lectures and put them online for students to view at their leisure. Better yet, the time freed up from delivering the same lectures year after year, course after course, could be spent putting together rich multimedia content that combines narrated PowerPoints, podcasts, Prezis, videos, VoiceThreads, etc.

In fact, why should faculty create their own lectures at all? Bowen notes that our system of faculty creating their own lectures is a bit like having every instructor write his or her own textbook. If faculty wrote all of their own textbooks, most textbooks would be terrible. Why not just use the best lectures that have been posted on iTunesU, TED, etc. for content?
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>xi</td>
</tr>
<tr>
<td>The Author</td>
<td>xix</td>
</tr>
<tr>
<td>1 Engaging Students with Clickers</td>
<td>1</td>
</tr>
<tr>
<td>Generating Classwide Discussions</td>
<td></td>
</tr>
<tr>
<td>Generating Small-Group Discussions</td>
<td></td>
</tr>
<tr>
<td>Creating Times for Telling</td>
<td></td>
</tr>
<tr>
<td>Structuring Class Time</td>
<td></td>
</tr>
<tr>
<td>Making Class More Fun</td>
<td></td>
</tr>
<tr>
<td>2 Assessing Students with Clickers</td>
<td>39</td>
</tr>
<tr>
<td>Uncovering Student Learning</td>
<td></td>
</tr>
<tr>
<td>Evaluating Student Learning</td>
<td></td>
</tr>
<tr>
<td>3 A Taxonomy of Clicker Questions</td>
<td>71</td>
</tr>
<tr>
<td>Content Questions</td>
<td></td>
</tr>
<tr>
<td>Process Questions</td>
<td></td>
</tr>
<tr>
<td>4 Teaching Choices</td>
<td>113</td>
</tr>
<tr>
<td>Use of Class Time</td>
<td></td>
</tr>
<tr>
<td>Writing Questions</td>
<td></td>
</tr>
<tr>
<td>Student Response, Participation, and Grading</td>
<td></td>
</tr>
<tr>
<td>Classroom Choices</td>
<td></td>
</tr>
<tr>
<td>Small Classes</td>
<td></td>
</tr>
<tr>
<td>5 Technical and Logistical Choices</td>
<td>161</td>
</tr>
<tr>
<td>Technical Challenges</td>
<td></td>
</tr>
<tr>
<td>Vendor Selection and Adoption</td>
<td></td>
</tr>
<tr>
<td>Supporting and Promoting the Use of Clickers</td>
<td></td>
</tr>
</tbody>
</table>
Contents

Low-Tech Options
High-Tech Options

6 Why Use Clickers? 197
   Increased Student Participation
   Increased Student Engagement
   Frequent Feedback on Student Learning
   Final Suggestions

References 209
Index 215
Creating Slides and linking to Response

We create the slides containing questions in Microsoft PowerPoint.

Starting PowerPoint

To start PowerPoint, click on in bottom left corner of screen.

Click on All Programs

Scroll down to Microsoft Office and click to get

Then click on Microsoft Office PowerPoint 2007

Creating a new presentation in PowerPoint

Click on in top left corner

New

Choose Blank Presentation

Use first slide for title

Click on New Slide. Choose Blank

Click on Insert Tab. Click on Text Box. Draw text box.

Type the question and answers and set font etc.
Click on **Add-Ins**

![Interwrite Response](Image)

Choose **New Question**

Set the Question properties

![Interwrite Response PowerPoint COM Add-in](Image)

Click **OK**

Response icon 📚 appears on bottom left of slide.
To create next question, repeat the steps above. A quicker method might be to go to Home Tab, click on New Slide and choose Duplicate selected slides.

OR

Select the last slide, right click mouse and choose Duplicate Slide

Edit the question and answers.

Choose Add-Ins, Edit Question to set the properties for this question.

Save the presentation.
Collecting responses
Insert Response receiver.

To start the Interwrite Response software, click on All Programs.

Then scroll to eInstruction and click to get

Click on Response to get

Click on Response i.e. to start the application.

The Interwrite Response First Look window shown below is displayed.
1. **Select Database**
   The Records Database is the storage area in Interwrite Response where all the important information is kept. The system is set up so you can start using it right away. You can use the default Database, defaultDS.kdb, and start asking questions now. You have the option of creating your own Database if you share the Response system with other instructors, or if you want to have a separate Database for each of your Classes.

2. **Setup My Hardware**
   This is where you can setup and troubleshoot optional hardware configurations. In the Receivers section, you can:
   - verify your RF and High-Speed IR Receiver connections
   - enable your IR Receiver COM Port connection, and
   - enable Virtual Receiver.
   In the Configure Clickers section, you can:
   - configure your Interwrite PRS RF Clickers.
   - enable your Master RF Clicker, or your Interwrite Maestro.
   In the Test System section you can:
   - test your Clickers and Receiver to make sure they are sending and receiving signals, respectively.

3. **Create A New Class**
   The New Class Wizard walks you through every step required to set up your Class, from naming it to creating or importing the Class Roster. The Class configuration information and Class Roster are stored in your Records Database.

4. **Collect Responses**
   There are a variety of ways of collecting your students' responses in your Database:
   - direct Participation in a Session using PowerPoint or asking questions on the fly,
   - Self-Paced testing, or
   - Homework collection.

5. **Manage My Data**
   This is where you can manage any student information that you have already entered.

Close this window to continue.

The Response options will appear.
To launch the quiz, choose Collect Responses.

Click on OK

Impromptu Options are displayed. Click on OK.

The Response Toolbar should appear and should be similar to the following toolbar.

You may need to adjust the size of the toolbar and move it to a suitable position on the screen.

In Powerpoint, go to the Slide Show tab. Choose From Beginning.

The following message will appear. Choose Yes to begin the session.
Creating a new Class and Class roster

When Response starts, choose Create A New Class.

Follow the steps indicated by the New Class Wizard.

Click on Next on the Welcome window.

On the Class Information window, enter the Class Name. This is the only required field. Click on Next.

The Subjects/Section data is optional. Click on Next.

In the Clicker Type window, check the box for CPS IR i.e.

On the Create Roster window, choose:

- **Skip** - if you want to use the Clickers without assigning student details to each clicker or want to do so later.
- **Manually Enter** - to create a Class roster with student and clicker details.

The following form will be displayed.
Enter the student details, ensuring that each student is given a unique value for the Student ID field, which is the only compulsory field on the form.

- Choose Import from another class, if you want to base your roster on student details already created.

Once a class and class roster are set up they and the data generated in Response sessions can be managed in Manage My Data.

**Exercise:**
Create a new class called Celebs which has a number of celebrities on the class roster, similar to the following sample roster.

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>Student ID</th>
<th>Clicker ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cahill</td>
<td>Des</td>
<td>7</td>
<td>3042A9DA</td>
</tr>
<tr>
<td>Cole</td>
<td>Cheryl</td>
<td>8</td>
<td>3042A9AA</td>
</tr>
<tr>
<td>Cowell</td>
<td>Simon</td>
<td>9</td>
<td>3042A9DC</td>
</tr>
<tr>
<td>Doyle</td>
<td>Anne</td>
<td>10</td>
<td>3042A94D</td>
</tr>
<tr>
<td>Dunphy</td>
<td>Eamonn</td>
<td>11</td>
<td>3042A9DE</td>
</tr>
<tr>
<td>Fanning</td>
<td>Dave</td>
<td>12</td>
<td>3042A9B4</td>
</tr>
</tbody>
</table>
**Useful links**

EInstruction websites:
http://www.einstruction.com/

http://www.einstruction.uk.com/

**Starting a PowerPoint session**
http://www.youtube.com/watch?v=H3sIooYPlZs&feature=related

**Creating a class**
http://www.youtube.com/watch?v=yc41vqkii6o&playnext=1&list=PL414872AE34D8B6B1&index=3

**Create a Class Roster**
http://www.youtube.com/watch?v=nr4huFR__Mc&feature=related