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Enhancing Learning in the Classroom – One Click @ a Time

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Introduction

A Personal Response System (PRS) is technology that allows students to respond to their instructor's questions and receive immediate feedback. PRSs are also called Audience Response Systems, Classroom Response Systems, or simply **Clickers**. Although PRSs have been around in different forms (wired systems have been available for over 20 years), the changes in technology and the changes in students have made this the time to consider broader adoption. The question pursued in this paper concerns the effectiveness of PRS technology in engaging millennial students in more active learning. Also discussed are the reasons that faculty might have for adopting a PRS. What's in it for them?

What About the Millennials?

We have new students in the classroom; they are called millennials. The first millennial students (born 1982) started entering our classrooms in the early 2000s. No longer were students just proud to be at college. We started to see the students of the entitled generation challenge our prerequisites and core curriculum and heaven forbid, "an A grade doesn't stand for attendance?" (Greenburger). She observes that she knew things had changed when she read the 2009 UCLA freshman survey and noted that 72% of the freshmen last year thought they would get a PhD (notice I didn't say **earn** a PhD, but rather **get** a PhD). Surely 72% of them could not pass qualifiers or stay focused long enough to write a dissertation.²

Although we have long considered teaching innovations in the agricultural economics classroom (Dahlgran, 1990), the invasion of the millennial students has made a new set of considerations necessary for effective teaching. The characteristics of millennial students that are important to understand for engaging them in the learning process include: 1) highly protected and sheltered by parents, 2) highly scheduled by their parents, 3) motivated and goal-oriented and high achieving (but never allowed to fail), 4) team oriented but communicate through technology, 5) values formed by the Internet and technology, and 6) enormous sense of entitlement. These characteristics of millennial students require changes in the classroom to engage them. PRSs are not the total solution, but the characteristics of these students make this a great time to consider the use of clickers.

Teaching millennial students is different because they have different expectations. Today's millennial college students are technology savvy and experienced, they expect immediate feedback, and prefer active learning in a classroom environment that is often passive. PRSs respond to the learning preferences of these students. Since today's students have grown up with technology and are technology savvy, they expect to use technology in their learning environment. Because they are used

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² Those who teach graduate courses shouldn't think that you can sit back for awhile longer. Beware; they are applying for admission to graduate school.

to spending many hours interacting with computer games, they expect interaction in the classroom. Much of the time, however, these millennials have played these interactive computer games in private. No one else knows when they lose (and presumably they do sometimes). These students are uncomfortable offering answers publically to questions posed in the classroom; they do not like to stand out. Millennials are used to having their feedback (both positive and negative) in private. PRSs fit this situation very well. Answers are solicited individually and only the individual students know whether they got the answer correct.

Millennial students also tend to have short attention spans. They would like their instructors to provide “entertainment” in short time periods broken up by “other” things, while providing instantaneous feedback to them in private. Many students would like class time to be more like a computer game. So *Wii* (pun intended) will give it to them, at least in the form of interactive questions about what they are learning.

An unusual thing about millennials is that they often respond on course evaluations that they want faculty to “make them” come to class, but absolutely despise us taking attendance for attendance sake. A PRS fits this criterion well also. As our survey results suggest, clicker use does encourage students to come to class (which we sincerely hope enhances learning). More importantly, the survey asks the students to evaluate whether or not the use of clickers enhances their learning. The authors believe there are several reasons why millennial students seem to like the use of clickers to meet these expectations. Now the relevant question becomes, why should faculty be interested in using these technological devices?

Why Should Faculty Be Interested?

Why would faculty want to use PRSs? Of course, we would expect that they would want to be more effective teachers of these millennial students, but there are other reasons.

Faculty realize that the “automatic” respect shown to professors in the past because of their place in life is much less than it used to be. Students have very little innate respect for faculty – remember these are the kids that can “look up anything on Google,” so why do they need to respect what faculty know? To counteract this tendency, faculty must help students see that they are learning – not just sitting there being entertained. One of the most useful tools of the PRS is the ability to introduce a learning topic by showing them they don’t always know everything they think they do.

Faculty must realize that students, in general, are not as committed to learning material. So, faculty can use the PRS to show the students that they can address problems and get answers that are not just recall. The immediate response also signals to students that faculty are ready to move on as soon as the class members understand the material well enough to warrant moving on. Of course, faculty want to be sure that students understand the material before moving on. An advantage of the PRS is that it gives the teacher the ability to quickly see if the students have mastered the material and are ready to move on.

Faculty have more demands on their time than ever before and are constantly being asked to do more with less. Current pedagogy indicates that faculty should collect several grades or assessments from students each semester to fairly evaluate their overall performance and calculate the course grade. However, collecting more grades takes more time, especially grading and recording classroom performance measures. The ease with which modern PRSs allow faculty to collect, analyze, record and summarize data about student learning is attractive. Most PRSs will automatically store the student scores in course management systems (like Blackboard, Vista, ANGEL, Sakai, and Moodle). Therefore, faculty can collect lots of data about student performance, but actually decrease the time required for grading, recording and summarizing their scores.

We have identified several reasons why students and faculty might be interested in PRSs. Now let us describe in more detail how the systems actually work and how to use them in the classroom.

What Is a Personal Response System and How Is It Used?

The PRS consists of three components: 1) handheld remote devices, clickers, used by the students to enter their responses, 2) a receiver attached to the instructor's computer that picks up the radio frequency signals from the remotes, and 3) software to record and analyze the responses and track the data for scoring and exporting a course management system.

The typical process of using the PRS:

1. The instructor poses a question, usually multiple-choice, and starts the clock to receive responses, usually allowing 15 to 30 seconds, depending on the complexity of the question.
2. The students enter their responses by clicking on the letter or number corresponding to the answer they choose sending a unique signal to the receiver. Some systems also allow students to type in numbers or words.
3. Once the time for responding expires, the receiver logs the students' responses and produces a graph (a histogram) of the class's responses to view and discuss. The individual student responses are automatically saved for later use.
4. After class, the instructor can use the software to automatically score the individual responses and export the results for use in Excel and uploading to a course management system so students can track their performance.

The PRS we used for this study is the i>clicker from Macmillan, developed by four University of Illinois physicists in 1997.³ The students purchase the clicker remotes from the bookstore when they buy their textbooks. The cost is approximately \$40.00. The receiver and software are provided to the instructor free of charge.

The PRS can be applied in a number of ways to engage students and enhance learning. And, we are still innovating and learning new ways to use this technology. As a starting point, we believe that a PRS can

³ <http://iclicker.com/>. Other systems are available including TurningPoint's ResponseCard and eInstruction's CPSPulse and InterwritePRS.

contribute to the learning process in the following areas: **introduction** – stimulate interest in a new topic at the beginning of a learning unit; **motivation** – reinforce students’ preparation for class; **evaluation** – tells faculty how well students understand material so adjustments can be made; **application** – help students apply principles to examples; and **participation** – provide an incentive for class attendance.

Evaluation Methods

The primary objective of this survey was to assess the effectiveness of the PRS in contributing to the learning process. The secondary objective was to observe how students’ opinions about the technology changed between the beginning and end of the course.

Pre-use and post-use surveys were administered in three courses to a total of 300 students during Fall Semester 2009. The questionnaires were designed to solicit the students’ opinions with regard to the following: value of immediate feedback, influence on class attendance, clicker facilitated students’ learning, clicker was worth its cost, clicker caused students to read the assignments, remembering to bring clicker to class, and clicker system accuracy.

To evaluate the effectiveness of the PRS, we conducted a pre- and post-surveys to elicit student opinions in three agricultural economics courses in Fall Semester 2009.⁴ The three courses and the enrollments in each were:

Course	Instructor	Pre-Use Survey	Post-Use Survey
AGEC 315 Food and Ag Sales	Kerry Litzenberg	108	65
AGEC 422 Land Economics	Gene Nelson	94	67
AGEC 424 Rural Entrepreneurship	Ed Rister	94	91

The Post-Use Survey Results

Value of Immediate Feedback. How did students value the immediate feedback they received from the PRS? Earlier we discussed the tendency of millennial students to expect instant gratification. They want to see the results right away. Did they answer the clicker question correctly? We would also argue that this feedback is an important part of the learning process. The PRS can be used to provide this

⁴ Litzenberg has varied approaches to using the clickers. Sometimes the clickers were used in an “outset” situation where students responded to what they thought were correct responses and then the correct answers actually formed the motivation for the learning. Other times Litzenberg used the clickers to be sure the students understood the material before moving on to new material. Administration of the clicker questions was done at different times during the class: sometimes at the beginning, sometimes as a summary at the end of the class, but usually they were used throughout the class period. Nelson asked an average of five questions during the 75 minute lecture period. One question every 10 to 20 minutes.

feedback. A question can be posed to test their understanding of the concept, principle, or fact. Then those students who answer correctly can confirm their understanding and students who don't can learn the correct answer and maybe more importantly review why that is the correct answer.

What did the survey say? In the post-use survey, students were asked to respond to the question: "How valuable was the immediate feedback from the clicker?" A large number, 79% of the total, said the immediate feedback of "very valuable" or "quite a bit," and another 14% said it was of "some value." (Figure 1). Although there was some variation among the three courses, it does not appear to be significant.

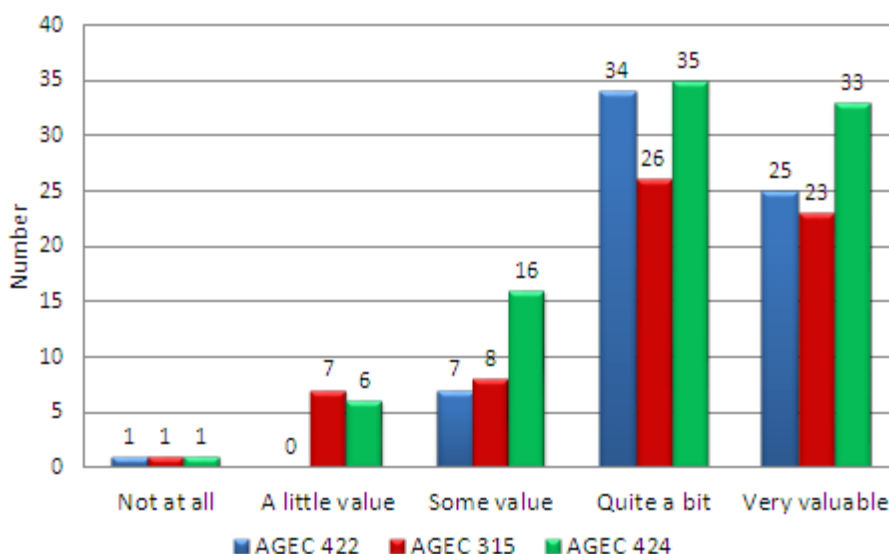


Figure 1. How valuable was the immediate feedback from the clicker?

Class Attendance. Our observation is that attendance has become an increasingly important issue in the classroom. Some faculty assign seats and take attendance each class, others use incentives such as pop quizzes, and others don't require attendance and let the chips fall where they may. The PRS provides a good compromise. Now, be sure to note that we are not advocating the PRS as a quick and easy way to take attendance. It can be used in that way, but this would under-utilize the potential of this tool. And, the students would be frustrated with buying a clicker/remote to simply make it easier for the instructor to take attendance. On the other hand, does the use of the PRS have a positive impact on attendance because of a more dynamic classroom environment resulting from the immediate feedback? The PRS also allows the instructor to award points for responses. For example, one scheme is to award 1 point for a correct answer and $\frac{1}{2}$ point for an incorrect answer. These points can be counted toward the total points for the course, thus, providing some incentive for attendance.⁵

⁵ For Nelson's AEC 422 course, the total clicker points amounted to 100 out of 700 points for the course. For Litzenberg's class the clicker points were approximately 200 out of 750 points for the course.

The survey results indicate that the PRS had a positive influence on class attendance. Fifty-nine percent responded that as a result of using the clicker, their class attendance “increased somewhat” or “increased significantly,” while 38% said that it had no effect. The impact was not as great in Rister’s AGECE 424 course because he uses other measures to encourage attendance.

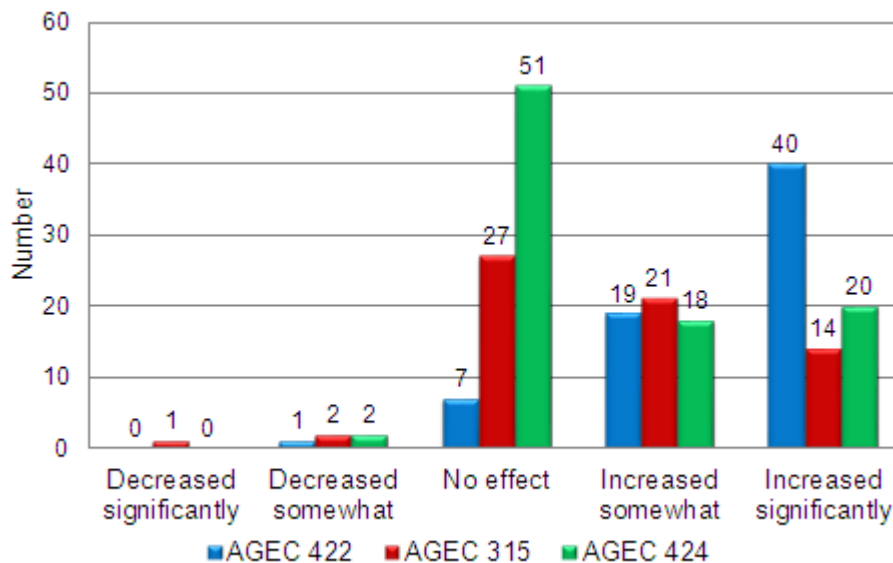


Figure 2. How did the clicker affect your class attendance?

Facilitation of Learning. The bottom line is whether or not the PRS helped students learn. Here the post-use survey results were very positive. When presented the statement: “Using the clicker facilitated my learning in this class,” 78.5% agreed or strongly agreed. The results are summarized in Figure 3.

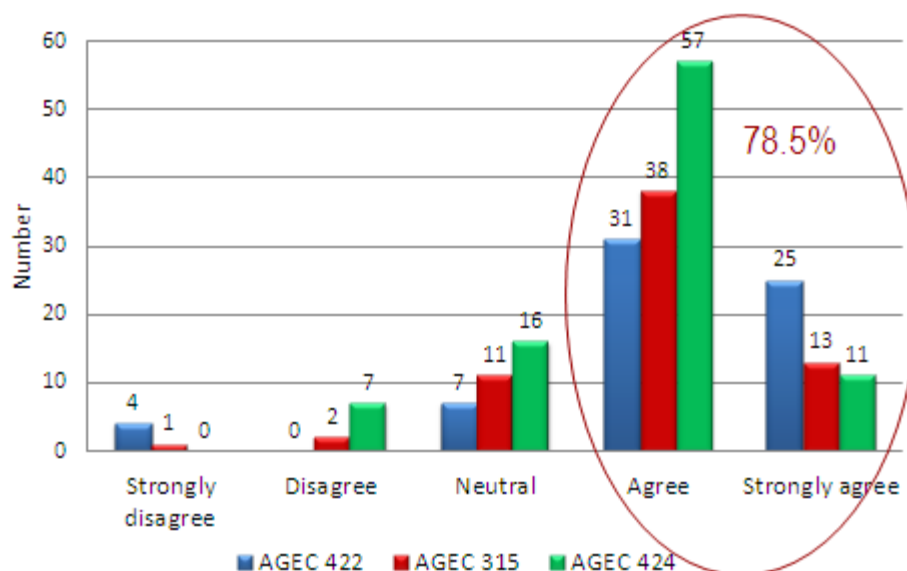


Figure 3. Using the clicker facilitated my learning in this class.

Cost/Benefit Comparison. The retail cost of the clicker/remote incurred by the student is approximately \$40. The students were asked whether they agreed with the statement, “Using the clicker was worth its cost.” Overall, across the three courses, 42% agreed or strongly agreed that clicker was worth its cost. Another 36% were neutral and only 22% disagreed or strongly disagreed. See Figure 4.

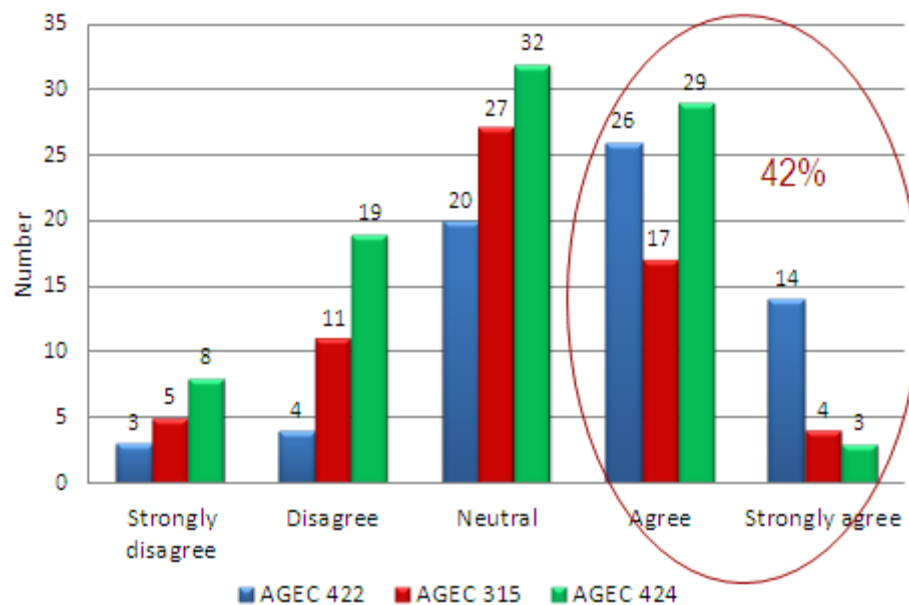


Figure 4. Using the clicker was worth its cost.

Encouraging Preparation for Class. Will the PRS encourage students to come to class better prepared to engage in the learning process? Based on the survey results, the answer is that it depends on how the PRS is used by the instructor, i.e. what types of questions are asked. The results in Figure 5 were mixed and varied by course. The predominant response of the students was neutral when asked about agreement with the statement, “The clicker encouraged me to read the assignments before class.”

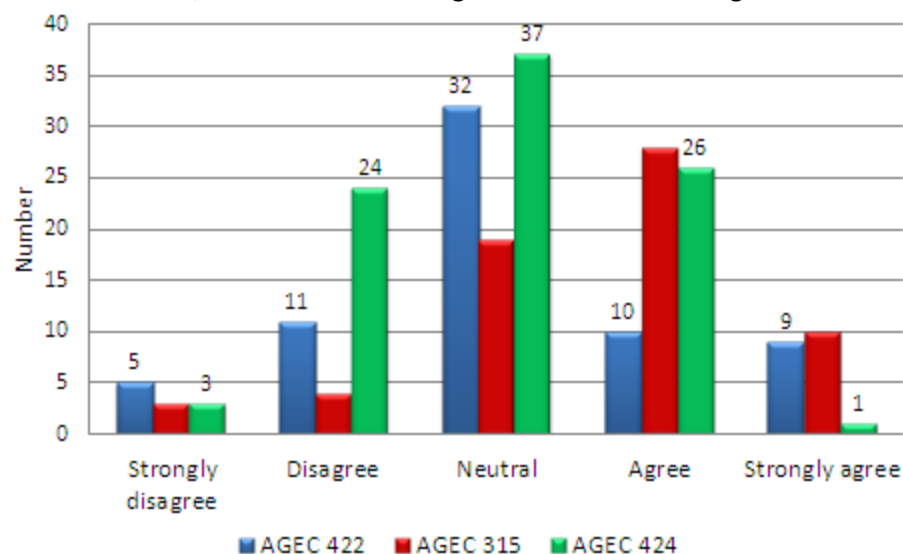


Figure 5. The clicker encouraged me to read the assignments.

Bringing the Remotes to Class. One of the concerns of faculty when considering the adoption of the PRS technology is whether or not students will remember to bring the clickers/remotes to class. The survey asked the students to respond to the statement, “It was difficult to keep track of the clicker and remember to bring it to class.” Figure 6 shows that 77% disagreed or strongly disagreed.

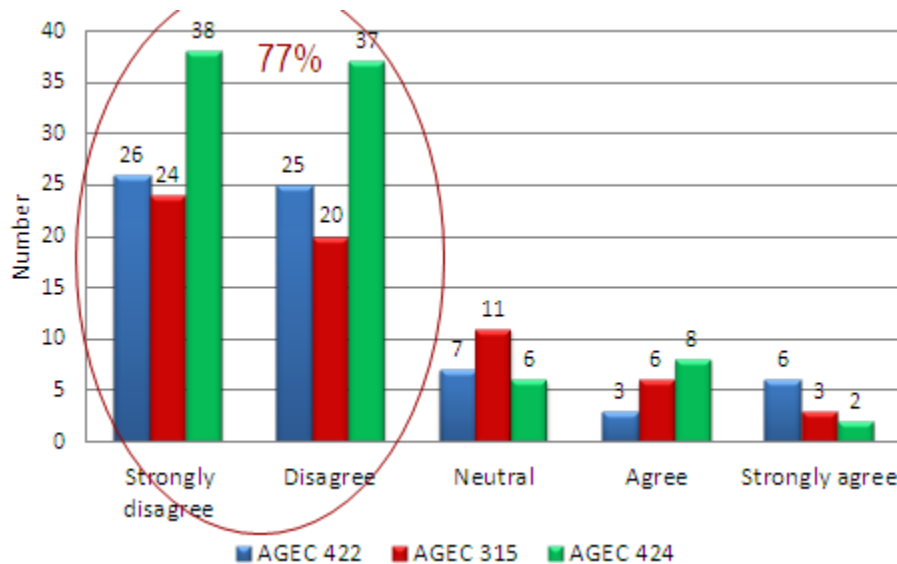


Figure 6. It was difficult to keep track of the clicker and remember to bring it to class.

This response was corroborated by another question on the survey that asked, “How many times did you forget the clicker?” A total of 63% of the students responded that they didn’t forget to bring their clickers to class. See Figure 7. The authors believe it is important that the clickers be used in almost every class. If clickers are used infrequently, students begin to forget them. Litzenberg has experimented with “loaner” clickers (4-5 for 60 students), which can be assigned to students for just a single period. Although this could encourage bad habits, it addresses the issue of forgotten clickers significantly impacting a student’s grade.

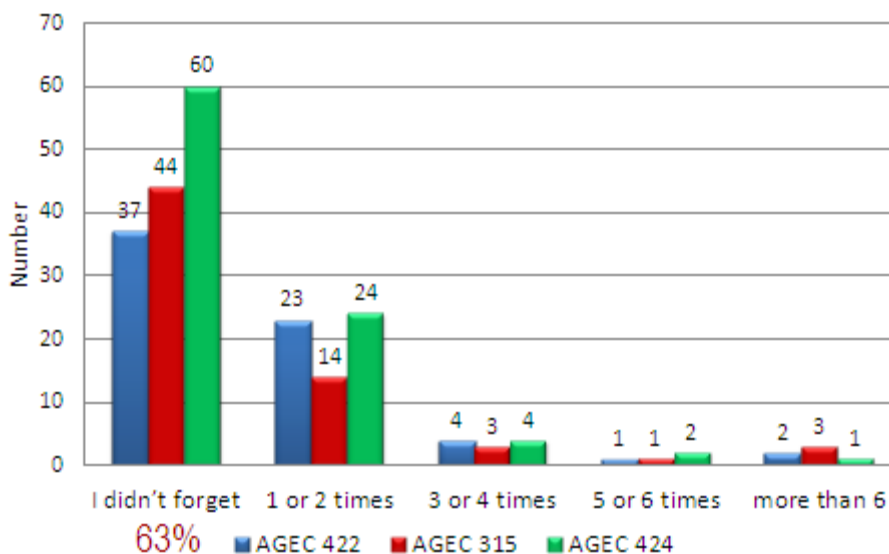


Figure 7. How many times did you forget the clicker?

Perceived accuracy of the PRS. Finally, if the students do not believe the PRS is accurately recording their responses and accounting for the points earned, the value of the PRS as a teaching tool is compromised. The survey results suggest, however, that the students have a high level of confidence in the system. As indicated in Figure 8, 70% of the students believed that the PRS was accurate 95% of the time or more.

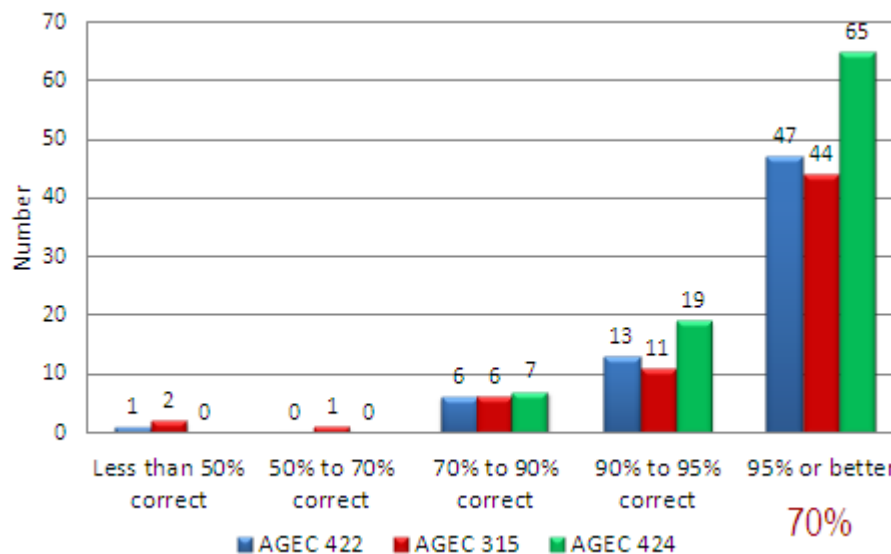


Figure 8. What percent of the time was the PRS accurate?

Now let's examine how attitudes changed between the beginning and end of the semester.

Pre-Use Survey and Post-Use Survey Results

To assess how attitudes about the use of the PRS changed during the semester, similar questions were asked in the pre-use survey and the post-use survey. The results are reported here for those students who completed both surveys.

Value of Immediate Feedback. How did students value the immediate feedback they received from the PRS at the end of semester compared to how they thought they would value it? At the end of the semester, 36.3% of the students thought that immediate feedback was very valuable compared to 23.1% at the beginning. Some of this change came from students who thought that the immediate feedback would be "quite a bit" of value, but more of the change came from students who responded that the immediate feedback would be "some value." See Figure 9.

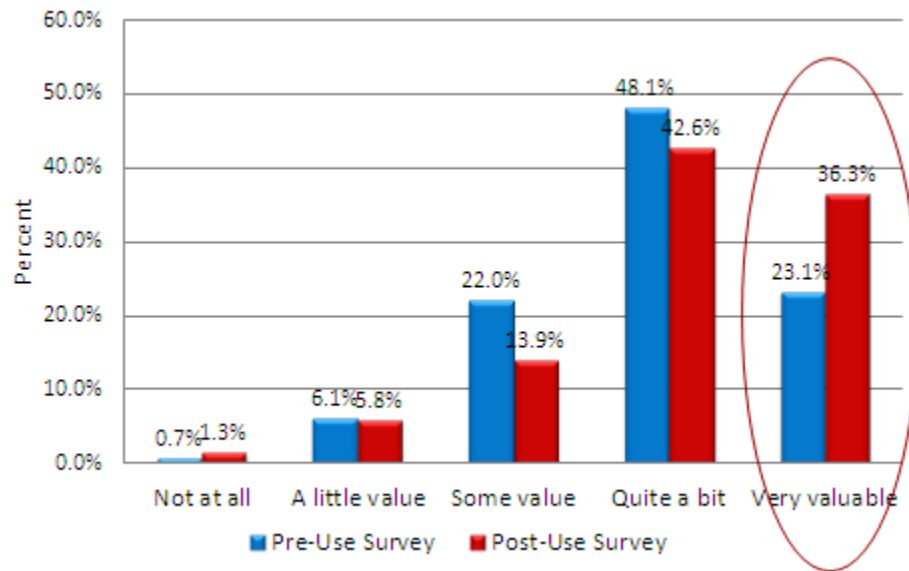


Figure 9. Post-Use Survey Value of Immediate Feedback Compared to Pre-Use Survey Predictions.

Facilitation of Learning. At both the beginning of the semester and the end of the semester, the students were asked about whether the PRS will (or did) facilitate learning. In the post-survey results, 22.0% of the respondents “strongly agree” with the statement that using the PRS facilitated learning compared to 8.8% who thought it would before they actually used the technology. Figure 10 illustrates the differences in the pre-survey and post-survey results.

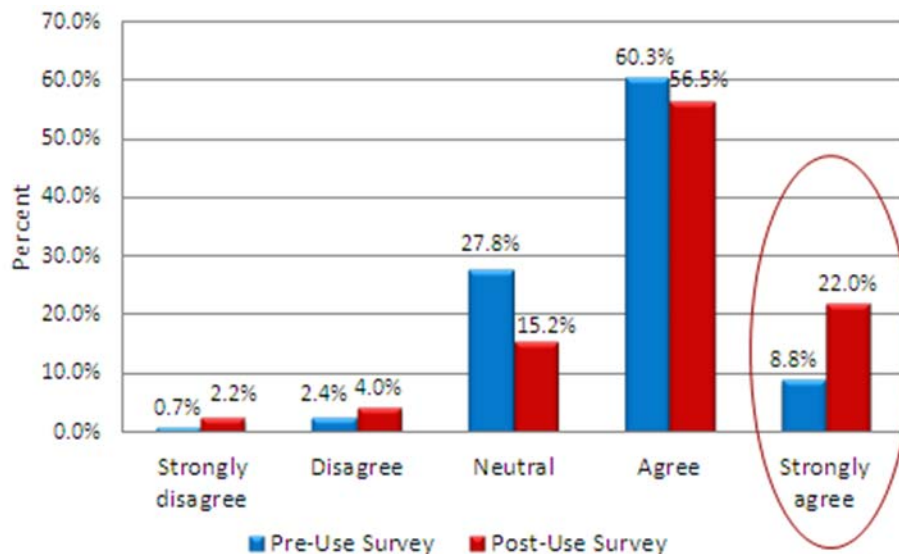


Figure 10. Post-Use Survey Opinions About Facilitating Learning Compared to Pre-Use Survey Attitudes.

Remembering the Remotes. The students did better than they thought they would in remembering to bring their clickers/remotes to class. In the post-use survey, 63.2% said they didn't forget. At the beginning of the semester, 51% thought that they wouldn't forget. See Figure 11.

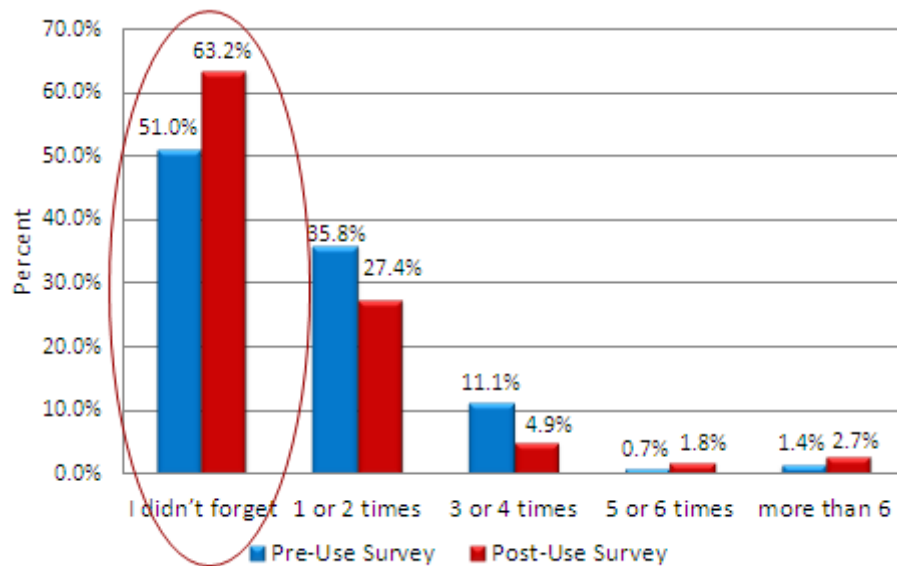


Figure 11. Post-Use Survey Results About Forgetting the Clicker Compared to Pre-Use Survey Expectations.

Accuracy of the PRS. The biggest difference in the pre-use and post-use survey results related to the perceived accuracy of PRS. Over the course of the semester, the percent of students who thought that the system would be accurate increased from 41.2% to 70.3% (Figure 12).

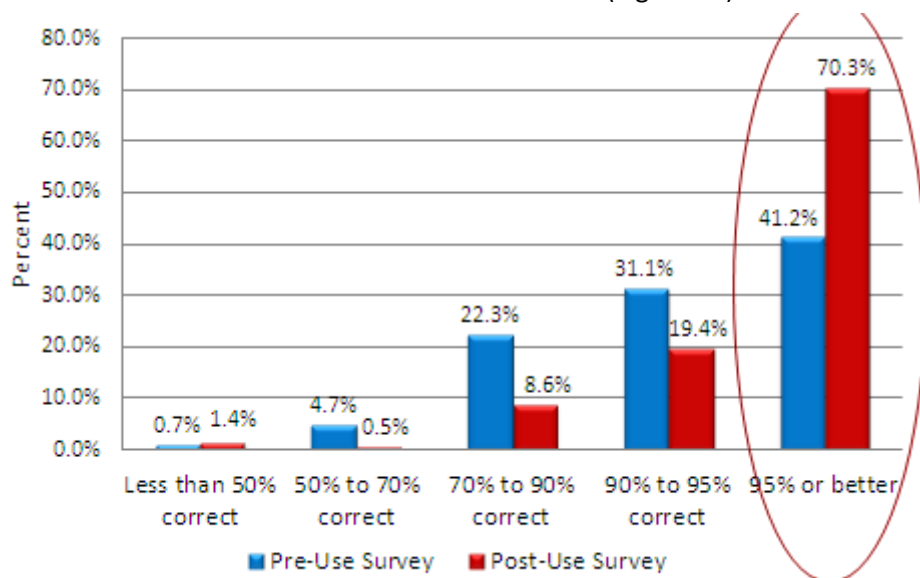


Figure 12. Post-Use Survey Results About System Accuracy Compared to Pre-Use Survey Results.

The Bottom Line: The Final Question. Did the students like the PRS or not, and how did their opinion change compared to the beginning of the semester? Overall, there was a high level of agreement that the students would and did like using the PRS (Figure 13). And, those responding “strongly agree” that they liked using the clicker in class increased from 6.4% to 20.9%. Those with “neutral” opinions decreased from 30.3% to 15.7% from the beginning and the end of the semester. At the end of the semester, a total of 76.5% of the respondents agreed or strongly agreed that they liked using the clicker.

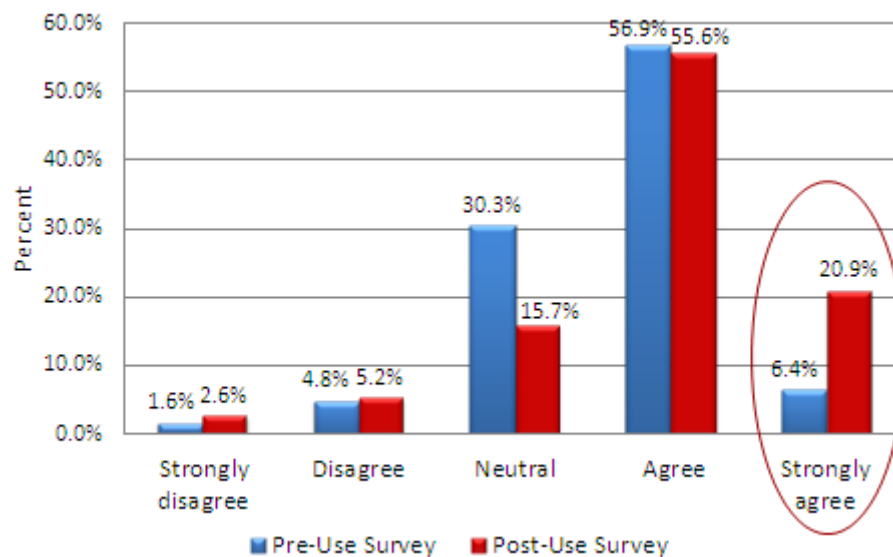


Figure 13. Post-Use Survey Results About Liking to Use the PRS Compared to Pre-Use Survey Results.

What Have We Learned About Teaching with PRS?

One of the issues for faculty is that the use of a PRS in the classroom requires preparation beforehand. Although the clicker software allows for questions to be developed “on the fly,” composing the good questions is the key to successful use of a PRS and that requires thought and planning. Bruff (2009) states that faculty must “become intensely intentional about their teaching – moment to moment.” Faculty who are using the clicker response systems for the first time almost always remark about the time it takes to create the questions. Also, the flow of the class period must be planned carefully to know when to ask clicker questions. Timing is important, especially if you are using the clicker to introduce a topic or to summarize learning of a topic.

Good pedagogy with clicker technology makes use of several different types of questions, depending on the learning objectives to be achieved:⁶

1. **Recall-of-Information Questions** are the easiest to write, but only accomplish the lowest level of cognitive thinking. To reach higher levels of cognitive thinking, the instructor must develop conceptual and application questions.

⁶ Question types 2-4 and 6 are based on Bruff (2010).

2. **One-Better-Answer Questions** require students to weigh evidence for and against each of the alternative answers and to select the “better” answer.⁷ This type of question is not simply recall of facts, but also requires application, analysis, and judgment. The information provided may not be complete. There is one better answer, but other answers may be defensible. This type of question functions well to promote class discussion. Using clickers and asking students to commit to an answer beforehand means that the students will be more committed to defending their answers and will have generated some ideas to share.
3. **Student Perspective Questions** ask students to share their opinions and personal experiences. For example, the instructor might ask students about their views on current events. The idea is to help students with the process of applying the sometimes abstract concepts to their own lives. Students are sometimes surprised to see how many of their peers agree or disagree with them on particular topics. This will encourage some students to speak up because they know that others agree with them. Others will recognize that some students have perspectives different from their own. Here the anonymity of the clicker responses is important. Asking for a show of hands is not likely to give the same results.
4. **Misconception Questions** are designed to reveal common student misconceptions about the course content. For example, does a change in price cause a shift in the demand curve? A well-designed misconception question should result in incorrect responses by 30 to 70 percent of students. Developing these questions requires more time, because the instructor has to anticipate the misconceptions. Once the results are shown, the instructor can explain the misconception, or he or she can use this as an opportunity for peer instruction. This involves asking the students to discuss the question in pairs, sharing their reasons, and attempting to reach an agreement about the correct answer. Then the instructor would ask the students to respond again to the clicker question to see what they have learned from each other.
5. **Free-Response Questions** involve a free form approach working with the students to develop the answers to the questions and then asking them to “vote” on which they think is the best answer. Although this approach takes considerable class time, allowing the students to develop their own list of alternative answers increases the learning even more.
6. **Peer Assessment Questions** are used when instructors are asking students to assess each other's work, such as feedback on student presentations. Because students are often hesitant to offer public critiques, the resulting discussion often does not involve the kind of critical analysis one would like to see. Asking these questions using a PRS, however, allows a more in-depth assessment and constructive criticism of the peers' work. The content of the questions themselves also helps the students to understand the standards of the profession.⁸

One ongoing issue the faculty must address is when to give the feedback from the clicker question. While there is considerable pressure (from both the students and the faculty) to immediately give the

⁷ Bruff (2010) refers to these as “One-Best-Answer” questions, but we believe this terminology is more descriptive.

⁸ Litzenberg has experimented with showing videos of student presentations and then asking the students in the class to critically evaluate the presentation and present ways to improve the presentation. This is an example of using the personal response system to guide the students to using the responses to the clicker to initiate the thinking process.

“correct” answer, alternatives can often initiate classroom discussion. Bruff (2009) suggests the use of the “Think-Pair-Share” approach where students are asked to respond to the question, but just before the correct answers are given, the students are asked to pair up with another student to check their answers. This “sharing” before responding encourages team thinking. Sometimes a peer's explanation of a concept can be more helpful to a student than the instructor's explanation.

Another approach is to solicit the answer to a question, show the histogram of accumulated responses, and then allow students to change their answers depending on the group dynamics. This approach shows students the influence of “group think” and the impact of strong proponents of a particular point of view. Sometimes, the clicker question is for the faculty member's information (for example, “how many people have read this article”), and the actual answers may not be shared with the class. Occasionally, a question may be posed, clicker responses solicited, and the histogram the classes' responses shown without revealing the correct answer. Then instruction and class discussion proceeds and then this is followed by asking the question again to see if the predominant response has changed.

One recommendation we would make to new users of the clicker technology is to not use the clicker for the sole purpose of taking attendance. The authors have observed that students really react poorly if the clicker is just used to check attendance because this does not help them learn (in their mind – even though we think we know it is good to get them to class). In fact, students seem to resent being “checked up on.” If you are planning to use the clicker to just register attendance, be ready for some push back from students. We suggest you incorporate the clicker into your learning outcome plans for the course and for each class.

Conclusion

The survey results are generally positive, and the authors are encouraged to continue to develop their skills in posing questions and evaluating student responses using PRS technology. The results show that using the technology seems to be worth the cost to the students, as well as the increased time required by the instructor to use the system effectively. The responses from students indicate that class attendance is encouraged by the use of the technology. The authors are convinced that using the technology embraces the millennial student and their learning preferences. The class periods are broken into more manageable segments for most students, and they believe that their learning is enhanced.

References:

- Boyer, Tracy A., Brian C. Briggeman, and F. Bailey Norwood. "Demand for Multimedia in the Classroom," *Journal of Agriculture and Applied Economics*, 41, 3 (2009): 791-808.
- Bruff, Derek, "Multiple-Choice Questions You Wouldn't Put on a Test: Promoting Deep Learning Using Clickers." *Essays on Teaching Excellence*. 21(3) (2010). Volume 21, Number 3, 2009-10.
<http://www.podnetwork.org/publications/teachingexcellence/09-10/V21,%20N3%20Bruff.pdf>
- Bruff, Derek, *Teaching with Classroom Response Systems: Creative Active Learning Environments*. Jossey-Bass, San Francisco, 2009
- Carnevale, D. "Run a Class Like a Game Show: 'Clickers' Keep Students Involved." *The Chronicle of Higher Education*. 51 (2005): 1.
- Dahlgran, R.A. "Teaching Innovations in Agricultural Economics: An Economic Approach." *American Journal of Agricultural Economics*. 72(1990): 873-82.
- Greenberger, Ellen, *et al.* "Self-Entitled College Students: Contributions of Personality, Parenting, and Motivational Factors." *The Journal of Youth and Adolescence*. 37 (2008): 1193-1204.
- Trees, A.R., and M. Jackson. "The Learning Environment in Clicker Classrooms: Student Processes of Learning and Involvement in Large University-Level Courses Using Student Response Systems." *Learning, Media and Technology* 32(2007): 21-40.

For a bibliography of publications on personal response systems prepared by Derek Bruff, Vanderbilt Center for Teaching, go to <http://cft.vanderbilt.edu/docs/classroom-response-system-clickers-bibliography/>