EDUCAUSE Center for Applied Research

Research Bulletin

Volume 2007, Issue 10

May 8, 2007

Student Response Systems:

A University of Wisconsin System Study of Clickers

Robert Kaleta, University of Wisconsin–Milwaukee

Tanya Joosten, University of Wisconsin–Milwaukee

4772 Walnut Street, Suite 206 ◆ Boulder, Colorado 80301 ◆ www.educause.edu/ecar/

Overview

Student response systems, or clicker systems, are increasingly being adopted by faculty and are transforming traditionally passive lecture courses into stimulating and active classes (EDUCAUSE Learning Initiative, 2005). A student response system is a wireless response system that provides faculty the means to actively engage students in lecture classes. Faculty members can pose questions at pedagogically strategic moments in class and allow students to respond with a personal response unit, or clicker. Student response systems provide faculty members with an opportunity to integrate new pedagogical applications into lecture classes and create a more engaging experience. Both faculty and students have reported that they like using clickers, and a number of positive outcomes of using clickers in the classroom have been discussed (Duncan, 2005).

In order to better understand clickers and their impact, this research bulletin shares the experiences of four University of Wisconsin campuses, UW–Milwaukee, UW–Eau Claire, UW–Oshkosh, and UW–Whitewater, in implementing clicker technology in the fall of 2005. It presents some of the initial results of the research conducted on the use of clickers in the classroom and reports on lessons learned. It describes what student response systems are, how they are used for teaching and learning, how clicker use impacts teaching and learning, and what considerations should be used to guide campuses when considering implementing clicker systems.

Highlights of Student Response Systems

A clicker system consists of three components. First, faculty use the system software to design an interactive presentation or a series of polling slides that contain questions to be posed to students during lecture. Depending on the system being used, the software can be either a stand-alone application or a PowerPoint plug-in. Once the polling slides have been created, faculty members transfer their presentations from their office computers to the classroom computers through a campus network or portable media device such as a flash drive, or they bring the presentation to class on their laptops. In cases where faculty do not have a laptop to bring into the classroom, the software must be installed on the classroom computer in order to poll students and analyze their responses.

Once in the classroom, faculty pose questions at pedagogically strategic moments in the course and allow students to respond using the second component of a student response system, the **personal response unit** or **clicker**, to send their responses to the classroom computer. These personal response units vary in size from the equivalent of a large television remote to that of a credit card, but they all essentially do the same thing. Students press a number from 0 through 9 to indicate their response to the question being asked by an instructor. The third component of a student response system is the **receiver**, which usually connects to the computer being used in the classroom through the USB port and captures responses from students' clickers (see Figure 1).

Figure 1. Personal Response Unit (Clicker) and USB Receiver

Once the responses are captured by the receiver, the software compiles the responses and makes them available to the class in a graphical representation on the class projection screen. Some software allows for real-time cross tabulation, making it possible to compare responses between two questions, such as pre- and post-test questions, or to group responses by demographic variables. After returning to their offices, faculty can generate reports such as grade results, student responses, questions results, or demographic group responses to use for evaluating the class session and for grading.

One common way in which clicker systems are used in the classroom is to stimulate classroom discussion. Faculty pose a question to students. The question can be an opinion question, it can deal with a controversial issue, or it can require complex understanding of a topic. After students have initially responded to the question, faculty then either pair students to discuss or have a class discussion about the polling results. The question and the students' collective responses serve as a springboard for discussion, fostering critical thinking skills. Then, the faculty member re-polls the students to see how their knowledge, attitudes, or opinions have changed as a result of the discussions.

Another way in which clickers are used in the classroom is to assess students' comprehension of course material through low-stakes quizzing. Faculty ask students a factual or conceptual question and tabulate the results. This application of clicker technology allows students to gauge their own mastery of the material and provide faculty with feedback on students' understanding of concepts and content. There are a number of creative, pedagogically effective ways in which faculty can utilize clickers in their classes (Beatty, 2004).

Reports from faculty who are early adopters of student response systems have been positive. Faculty enjoy the opportunity to assess student mastery of course content and concepts during class, and students appreciate being able to determine their level of comprehension. Faculty report that integration of clickers into their courses changes the dynamics of the class and results in greater student engagement and interaction. However, most of these reports have been either anecdotal or present data from a small number of courses. What has been lacking is a systematic, large-scale study examining the use of clickers for teaching and learning in higher education.

In order to evaluate the use of clickers for instruction and assess their impact in the classroom, the University of Wisconsin System supported a four-campus project,

Student Response Systems—Exploring Potential and Assessing Impact. The purpose of the project was to support faculty from the campuses in their efforts to integrate clickers into their courses; to create a model faculty-development program for preparing faculty for using clickers for teaching and learning; to develop a Web resource (http://clickers.uwm.edu) on the use of clickers for instruction in higher education; and to evaluate and assess the impact of clicker use.

University of Wisconsin Study Methodology

The study gathered evaluation data that examined faculty and student perceptions and attitudes regarding clickers, as well as assessment data that examined the impact of clicker use on retention and grades. During the evaluation, faculty members and students completed extensive surveys on the use and perceived impact of clickers. In addition, faculty participated in focus groups and completed written narratives on their experience using clickers. The courses involved in the study represented 19 disciplines and a variety of class sizes and course levels.

Faculty completed a 68-item, Internet-based survey in which they used a five-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree) to reflect their opinions on a number of statements related to the use and perceived impact of clickers. The survey was administered to 28 faculty members, and 27 of them responded. A 61-item, Internet-based survey with a five-point Likert response scale was administered to approximately 3,500 students, of whom 2,684 responded. The survey items were designed to evaluate the perceived impact of clickers on classroom engagement and student learning and to evaluate faculty and student satisfaction with the use of clickers for teaching and learning.

For example, faculty responded to items such as "Clickers increased student participation in the course" and "Clickers allowed me to assess student knowledge on a particular concept." Students responded to items such as "Clickers increased the frequency of my participation in the course" and "Clickers helped me get instant feedback on what I knew and didn't know."

To assess the impact of clickers on course grades and retention, the study compared grade and course completion data from courses taught without clickers during the fall 2004 semester to the same courses taught by the same instructor during the fall 2005 semester with clickers. Eleven courses met the criteria of being taught both fall semesters by the same instructor.

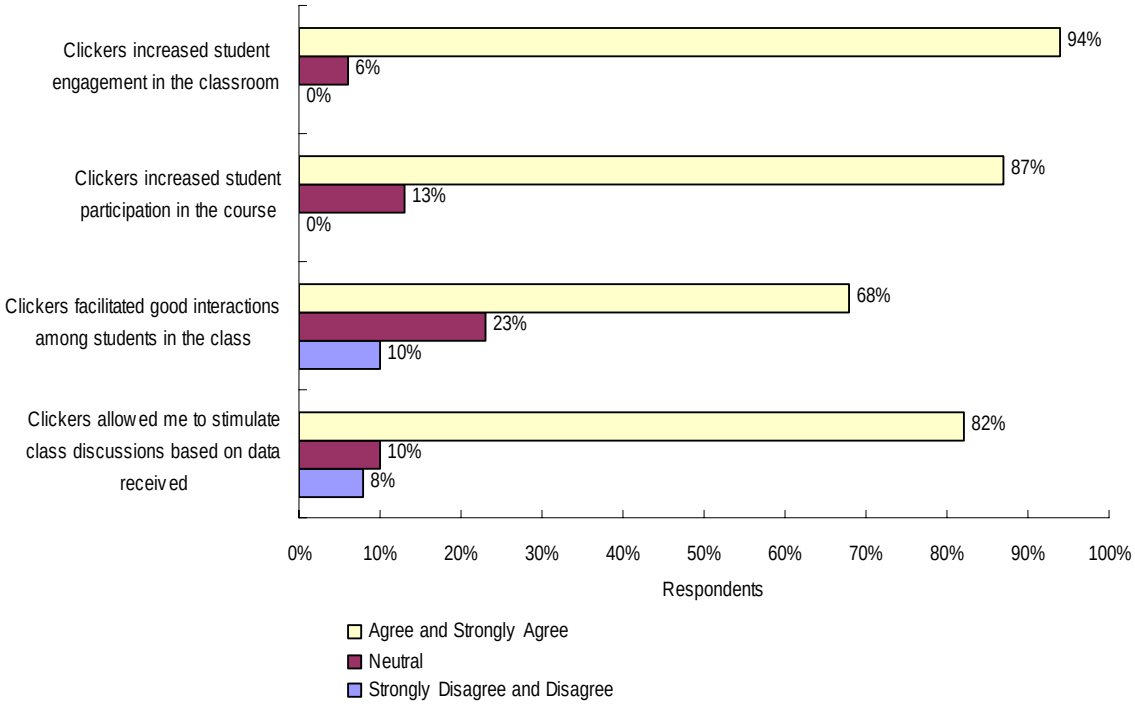
Benefits of Clicker Use

Overall, the data showed that both faculty and students liked using clickers and perceived the clickers as having a strong impact upon class engagement and learning. The assessment data showed that clickers had an impact upon student grades but not on course retention. It should be noted that as this was the first major effort to implement the use of clickers on these campuses, a number of technical and logistical challenges were encountered. Consequently, it was expected that the evaluation data would be inconclusive and that there would be no impact on student grades and retention during

the first semester of implementation. Everyone involved in the project was surprised at the positive results.

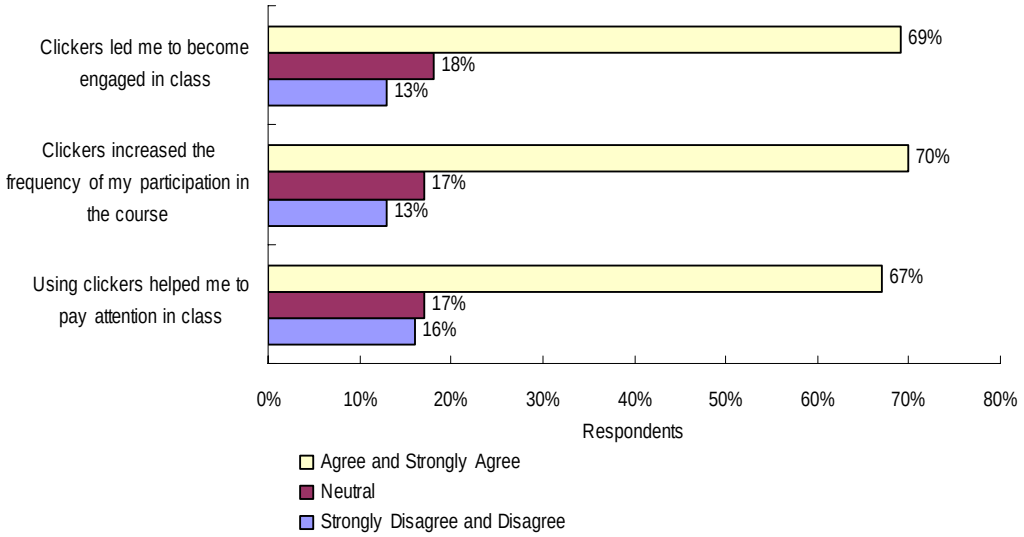
Classroom Engagement. Faculty agreed or strongly agreed that there was greater student engagement (94 percent), participation (87 percent), and interaction (68 percent) in class as a result of clicker use (see Figure 2).[1] In their narratives, faculty reported that one of their main uses of clickers was to stimulate discussion, and most of them (82 percent) felt that clickers allowed them to do this. Faculty reported that clickers equalized the classroom, allowed everyone to have a voice, and led to more stimulating discussions. One faculty member commented, "The clickers were very effective in stimulating discussion…I think that seeing that range of opinions made the students a little more willing to talk about their opinions."

Figure 2. Faculty Opinions about Engagement, Participation, Interaction, and Discussion



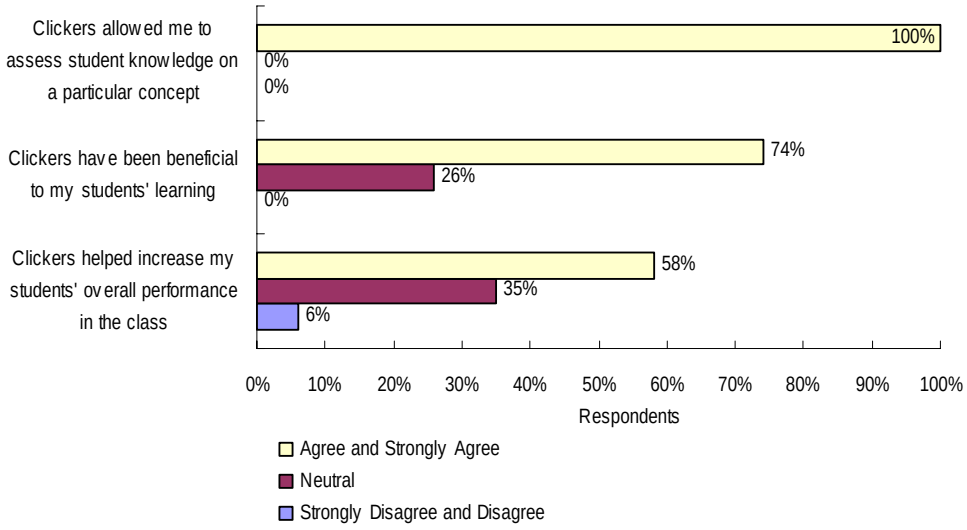
The majority of students also agreed or strongly agreed that the use of clickers made them feel more engaged (69 percent) in class, increased participation (70 percent), and helped them pay attention (67 percent) (see Figure 3). Students reported that clickers allowed them to participate in class discussion by answering questions without risking embarrassment for incorrect or naïve answers. A student included on the survey that "I liked how the clickers started discussions, especially if the question was especially difficult. The clickers also made me more active in class…"

Figure 3. Student Opinions about Engagement, Participation, and Attention



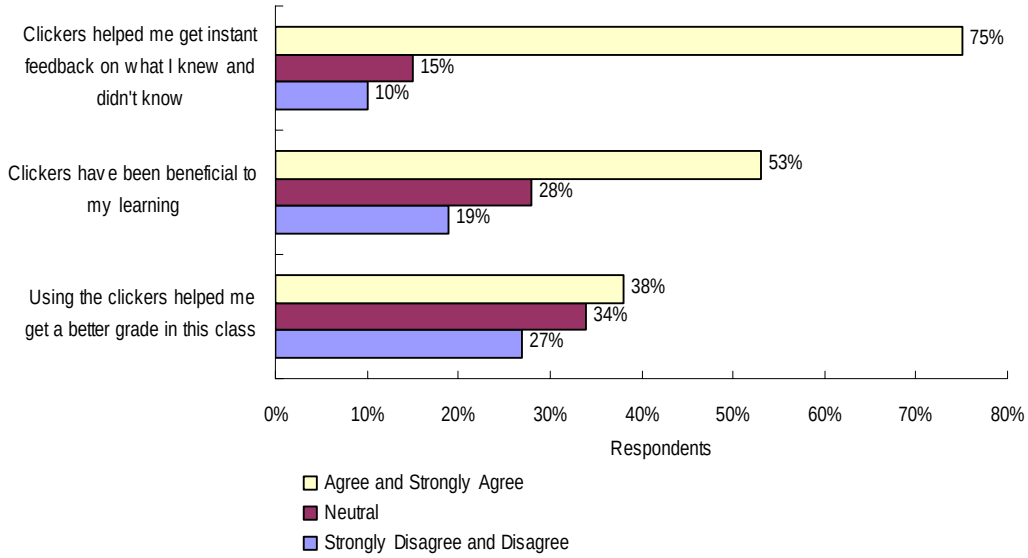
Student Learning. Faculty appreciated the ability to assess students' knowledge and understanding (100 percent), allowing faculty to target weaknesses with additional learning activities or a different style of presentation before moving forward. A large percentage (74 percent) of faculty agreed or strongly agreed that clickers improved student learning. The majority (58 percent) of faculty felt that clickers helped increase student performance in class (see Figure 4). Faculty appreciated that clickers help to identify times when it was necessary to "re-teach" concepts and material. As one faculty member mentioned, "By getting immediate feedback, I could judge whether students understood the basic concepts. If a vast majority answered the multiple-choice questions correctly, then I could confidently proceed onto the next topic of lecture. If a large number of students did not get the correct answer, then I could lecture some more and re-poll, or I could get the students to discuss amongst themselves what the correct answer should be."

Figure 4. Faculty Opinions about Assessment, Student Learning, and Performance



Students also reported that they felt the use of clickers in the classroom was helpful in learning the course material. A large percentage of the students (75 percent) agreed or strongly agreed that they liked getting instant feedback that allowed them to gauge their knowledge and mastery of the subject during the class period, and the majority (53 percent) reported that they felt the clickers were beneficial to their learning. Some students (38 percent) reported that clickers helped them earn a better grade in the course (see Figure 5). One student commented, "I was able to check my understanding of the concepts and refer back to clicker questions when it was time to study for an exam." Another said, "[I liked] knowing where you stand in knowledge of material as compared to your classmates."

Figure 5. Student Opinions about Feedback, Learning, and Grades



Student Grades. The statistical analyses of grade data collected for the 11 parallel courses between fall 2004 and fall 2005 showed a statistically significant impact of clicker use on student performance. T-tests of grade data indicate significant difference ($p < .05$) between clicker sections and non-clicker sections. In non-clicker sections, a grade of C or better was reported for 83.04 percent of the students in fall 2004. In clicker sections in fall 2005, 85.27 percent of the students earned a grade of C or better. There was an increase of 2.23 percent in the number of students obtaining a grade of C or better in the courses that used clickers. This increase is consistent with the qualitative data obtained from faculty and students, which show that they believe the use of clickers had a positive impact on learning and suggests that clickers may be a contributing factor to the increase in grades.

Student Retention. Data on student course completion for the 11 courses were gathered for the fall 2004 and 2005 semesters in order to examine retention rates. Descriptive analyses indicate a slight increase (1.34 percent) in course drop rate for the course using clickers, but a chi-square analysis indicated that this difference was not statistically significant. It was noted that there was substantial variability in retention rates among courses (6 courses showed a decrease in drop rates; 5 courses showed an increase in drop rates), with some courses showing a very large decrease in drop rates.

More data will need to be gathered before a determination of the impact of clickers on student retention can be made.

Pedagogy. Most of the faculty agreed or strongly agreed that the clicker systems afforded them opportunities to implement new pedagogical strategies (74 percent) and that they were helpful in introducing active learning strategies (84 percent) into the classroom. As one faculty member mentioned, “The clickers provided us another means for active involvement that was different, unique, and involved each individual student to some minimal extent.”

Satisfaction. The majority of faculty (81 percent) agreed or strongly agreed that their experience using clickers was positive. In addition, a large percentage (80 percent) said that they would continue to use clickers in the future and that they would recommend clickers (81 percent) to their colleagues. One faculty member commented, “I would like to encourage the use of this technology by more instructors…More importantly, I can see how this technology will help the university.”

The majority of students indicated in their surveys that the use of clickers in their course was fun (66 percent) and that they would take another course that made use of clickers (64 percent). The majority of students (59 percent) also agreed or strongly agreed that overall they were happy with the experience of using clickers in class. One student commented, “I would take another course with clickers because along with taking notes and listening in lecture, the clicker questions help keep you involved and paying attention to the ideas that the professor thinks are important.” Another student explained that, “They were a really fun and refreshing way to learn and participate in such a big lecture.”

Challenges of Clicker Use

Although faculty and student reaction to the use of clickers in the classroom was positive, there were some major challenges that they encountered. The qualitative data gathered in this study through focus groups, faculty narratives, and open-ended survey items reflected the issues that most concerned faculty and students. In general, the issues raised are those that accompany the adoption of new technologies and centered on training, support, time, and cost-effectiveness.

Learning Curve. Faculty reported that there was a rather steep learning curve in adapting to the clicker technology. It took faculty and students several weeks to become familiar with the technology, which some faculty found frustrating. However, faculty felt the faculty-development workshops, training, and support they received were pivotal in their success with clickers.

Time. Integration of clickers into the design of the class required a greater amount of time than many instructors had anticipated. Also, clicker activities consumed a considerable amount of class time, especially if discussions were linked to questions posed. This prompted faculty to focus on depth rather than breadth of material in the classroom and use alternative methods to deliver course content outside of lecture through the course Web site.

Technical Support. Faculty members sometimes felt overwhelmed when it came to supporting students' clicker problems, such as lost, broken, defective, or incorrectly registered clickers. Because this was a new technology and because campuses had not yet completely integrated clicker support into their campus help desks, students turned to faculty first for help whenever they had clicker problems. Furthermore, students have come to expect problem-free technology, so if the classroom computer was slow or if the faculty member seemed inexperienced or could not resolve problems quickly, students became critical of the clicker systems. Students made it clear that they want clickers that are easy to use and to register.

Cost and Use. Students were conscious about the cost of the clickers. They felt that faculty needed to use the clickers more often and that clicker use needed to be tied to their grade in the class to justify the costs. Students appeared to be saying that they would accept the cost provided that the clickers were used effectively and frequently by the instructor.

Response Confidence. Finally, students were not always confident that their responses were received by the system, even though the clickers provide feedback to students that their responses were successfully received. This created anxiety for some students, especially when faculty assigned participation points for clicker use in the classroom.

What It Means to Higher Education

The results of this study confirm what individual faculty members have been reporting regarding the impact of clickers in the classroom. Faculty and students perceive clickers as having a positive impact on student engagement and interaction in class, and they feel that clickers facilitate student learning. Faculty appreciate having the opportunity to introduce new active learning strategies into lecture courses to stimulate student involvement. Students report that they are now active participants in the lecture courses and feel like they need to come to class ready to participate and pay attention. Every student now has the opportunity to be involved in class, resulting in a change in classroom dynamics. Students are now willing to participate and contribute to the class. They can see how their fellow students are responding and see that they are not alone in their opinions. They can judge how they are learning in comparison to others in the class. Through discussions prompted by clicker questions, they are required to think through their thoughts and ideas to reach higher levels of critical thinking. The sense of anonymity makes students more willing to express their opinions in class and participate in subsequent class discussions. In summary, it appears that clickers may be the tool to address the old and unsettled question of how to make medium and large lectures more active and engaging for students.

In addition, students and faculty perceive clickers as facilitating student learning, and the data gathered in this study on student grades supports this perception. It should be noted that the statistically significant results related to the impact that clickers appear to have on grades may be much larger than was found in this study. The results of this study were likely attenuated by the fact that this was the first time most of the faculty had used clickers and that they had a very limited amount of time to design clicker-based

learning activities and integrate them into their courses. Furthermore, because the use of clickers was also new to the campuses, there were a number of implementation and technical problems that created difficulties for both faculty and students. In other words, the implementation was far from smooth, but there still was a positive impact on student grades. Longitudinal research is now under way to examine whether the impact of clickers increases as faculty become more proficient at using the technology and effectively integrating it into their classes.

Finally, both faculty and students reported that they like using the clicker technology and that they would recommend it to colleagues and friends. In addition to being reflected in the survey ratings, an often repeated message that came out of the students' written comments was that clickers were fun to use. Many students were enthusiastic and said they enjoyed using the clickers. While some in higher education are quick to dismiss such affective reactions to new approaches to teaching as interesting but unimportant, it should be remembered that getting students enthused and excited about learning is one of the things that should be happening in higher education. This enthusiasm and excitement lead to greater engagement and, subsequently, to improved learning.

Implementation Recommendations. To realize the benefits of clicker use, it is important that institutions address the challenges that faculty and students encounter when using student response system technology. As mentioned earlier, the qualitative data from this study identified some major issues that need to be addressed if clickers are going to be used effectively and successfully on campus. Here are five recommendations for implementing and supporting the use of clickers for teaching and learning:

1. To address the issue of the rather steep learning curve, institutions should create a faculty-development program to assist instructors with their efforts to integrate clickers into their course design and to train them on the technical aspects of using student response systems. To instruct students in clicker use and to foster their confidence in the technology, faculty should take time in class to show students how to program their clickers and use them for class learning activities.

2. Because the development and integration of clicker activities into the course typically takes more time than anticipated, faculty should be encouraged to begin their course redesign several months in advance of teaching the course. Also, campuses should consider giving faculty summer support or a course buy-out to redesign their course(s) for effective use of student response system technology.

3. As with any technology, particularly a new technology, user support is essential for success. Campuses need to integrate clicker support into their help desk activities. Help desk staff should be ready to assist students with issues related to programming and registering clickers and with situations where clickers do not appear to be operating properly. In addition, classroom technical support should be available for the first few sessions of clicker use in order to manage any problems that may arise.

4. Because clickers are another expense for students, institutions should negotiate the best possible pricing with vendors. To ensure that students are satisfied and benefiting from their investment, faculty should be encouraged to use the clickers a couple of times each class and to integrate these activities into the course assessment plan.

5. In order to most effectively address the training, support, and cost issues surrounding the use of student response systems, campuses should consider standardizing on one clicker system.

By addressing these issues, institutions can effectively manage the adoption of clickers and their integration into teaching and learning, and they can help make this transition a positive and beneficial experience for students and faculty.

Key Questions to Ask

- What are the advantages of student response systems for your campus?
- What are the most important factors to consider when evaluating and selecting a student response system for your campus?
- Which are the key campus units that should be involved in the implementation, distribution, and support of student response systems? Who should take the lead in coordinating this initiative?
- How will faculty learn about the pedagogically effective uses of student response systems?
- How will you assess and evaluate the impact of student response systems in your courses?

Where to Learn More

- University of Wisconsin–Milwaukee. Student Response Systems: The UW–System Clicker Project. Retrieved January 28, 2007, from http://www4.uwm.edu/ltc/srs/
- EDUCAUSE Resource Library: Student Response Systems. Available from http://www.educause.edu/Browse/645?PARENT_ID=697

References

- Beatty, I. (2004, February 3). *Transforming student learning with classroom communication systems* (Research Bulletin, Issue 3). Boulder, CO: EDUCAUSE Center for Applied Research. Available from http://www.educause.edu/ecar/
- Duncan, D. (2005). *Clickers in the classroom: How to enhance science teaching using classroom response systems*. New York: Pearson Addison-Wesley.

- EDUCAUSE Learning Initiative. (2005, May). *7 things you should know about…clickers*. Boulder, CO: EDUCAUSE Learning Initiative. Available from http://www.educause.edu/eli/

Endnote

1. Some data presented in the figures of this bulletin do not add up to exactly 100 percent as a result of rounding.

About the Authors

Robert Kaleta (kaleta@uwm.edu) is Director of the Learning Technology Center, and Tanya Joosten (tjoosten@uwm.edu) is a faculty instructional design consultant, at the University of Wisconsin–Milwaukee.