

Clickers in the Classroom: Transforming Students into Active Learners

Tena B. Crews, University of South Carolina

Lara Ducate, University of South Carolina

Jeanna Marie Rathel, Lancaster County School District

Karen Heid, University of South Carolina

Stephen T. Bishoff, University of South Carolina–Sumter

ECAR Research Bulletin 9, 2011

Overview

Engaged students are successful students. They earn better grades, have lower rates of attrition, and help their peers learn more. We know this intuitively, and a considerable body of research demonstrates it is true. The ongoing challenge for educators is how best to engage students during instruction.

Although technology is often cited as a source of distraction for students, in the case of a student response system (SRS), technology has the potential to increase student engagement. Often referred to as “clickers,” SRSs come in a variety of forms, but all consist of a remote control keypad or handset students use to respond electronically to questions from the instructor. An SRS requires students to focus and actively participate, and it gives faculty the opportunity to analyze and discuss each question as students respond. A central component of engagement is the degree to which students take an active role in their learning, and clickers are designed to facilitate this transition to active learning.

This research bulletin discusses a program at the University of South Carolina to implement SRSs in the classroom and to study the impacts the technology has on student outcomes. In our research, we also looked at the challenges SRSs pose, both to students and to faculty members, and investigated best practices for using this technology.

Highlights

In her book *Tools for Teaching*, Barbara Davis pointed out that students learn best when they are active participants in the education process—as they discuss readings and practice and apply course content, concepts, and ideas.¹ Rand Guthrie and Anna Carlin found that modern students are especially interested in learning in an engaged environment.² Charlotte Briggs and Deborah Keyek-Franssen noted that formative assessment plays a vital role in establishing an engaging learning environment in which students participate in their own learning.³ Many barriers stand in the way of such engagement, however. If faculty can identify the barriers between passive and active learning, an SRS might assist in eliminating those barriers.

One barrier, for example, is high enrollment in courses, which can contribute to less student participation. Joel Geske suggested that large-enrollment courses often result in an impersonal atmosphere and a decrease in student involvement.⁴ Courses with large enrollments can create an environment where the majority of students don't know one another, resulting in heightened inhibitions. This atmosphere leads to a reduced sense of student responsibility and can increase student anxiety about verbally participating in class.⁵ Conventional approaches to measuring student comprehension—asking for a show of hands, for example—are not always time-efficient or reliable because they do not offer an accurate measurement of feedback; students often do not respond truthfully, or do not respond at all.⁶

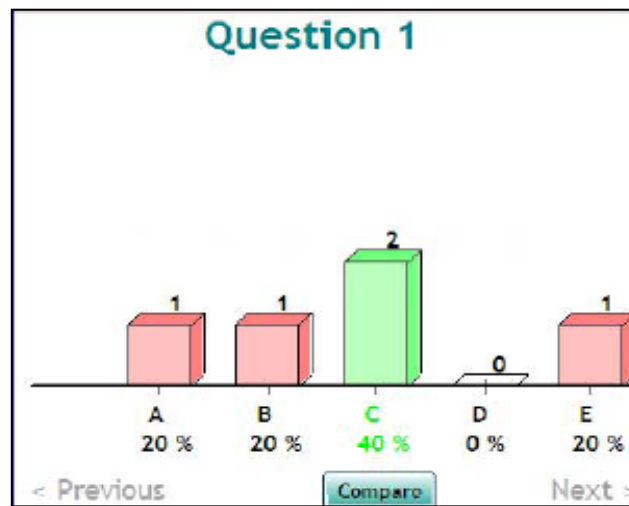
In contrast, an SRS can measure how much students are actually learning. Used well, an SRS provides valid and reliable classroom assessment through activities such as multiple-choice or true/false quizzes, tests/exams, participation or discussion questions, and/or introduction to a topic.⁷

Using Clickers to Spur Engagement

The introduction of SRSs to the classroom offers a method of engaging students and developing formative and summative assessments, which can increase student accountability and learning while improving attendance. Faculty can use clickers to generate participation, interactive peer learning, and instant feedback.

SRS technology allows educators to create multiple-choice, text, or numeric response question formats, depending on the specific type of SRS. Each student's handset transmits a response to the instructor's computer or SRS base, which displays the results on a projection screen for the class to see. The SRS software typically has the option of providing anonymous results or linking responses to individual students. The results are often viewed as a bar chart (see Figure 1), indicating how many students "voted" for each possible answer.

Figure 1. Sample Bar Chart of Clicker Responses



When responses are anonymous, SRS technology allows students to be engaged in class without feeling the pressure of always having to be right, given that it provides an opportunity for students to participate in a discussion without publically revealing their answers.⁸ Students who would not normally contribute to class activities might feel more comfortable participating in class discussions using an SRS.

Some students are not motivated to participate. Hands-on group activities or group discussions often lead to one student unwillingly carrying the weight of the group.⁹ Such exercises can also result in certain students doing nothing, acting as a "social loafer" in their groups. Lack of motivation can stem from intimidation, lack of preparation, or apparent disinterest. SRSs can address these situations as well by requiring every

student in attendance to respond to the questions posed before feedback can be offered. This encourages students to stay focused and involved.

Because an SRS can provide immediate feedback about student comprehension and progress, instructional strategies and activities can be adjusted as soon as gaps are identified. Ian Beatty noted, “Many instructors are quite shocked by how incorrect their expectations are of students’ comprehension.”¹⁰ Incorporating SRS activities during lecture provides an easy and convenient method for conducting ongoing formative and summative assessment.¹¹

An SRS can also be used to take attendance, another challenging task for large-enrollment courses. Moreover, assuming an SRS makes the classroom experience more enjoyable for students, it has the potential to encourage students to attend class. Michael Preis and G. M. Kellar, for example, found that 87.2% of their Principles of Marketing students were more likely to attend class as a result of using an SRS.¹² Clyde Herreid noted a 30% increase in student attendance when an SRS was used.¹³

Studying the Effects of Clickers

A grant sponsored by the Center for Teaching Excellence (CTE) at the University of South Carolina funded a project during a summer term to study the effectiveness of student response systems. Through this grant, the CTE created four goals for faculty development and teaching improvement:

- To foster student engagement in the classroom
- To encourage peer instruction and formative assessment to enhance learning
- To discover how an SRS can assist students in their learning experiences, resulting in revised instructional procedures
- To encourage faculty to develop processes to implement the use of an SRS

For the project, five-button iClickers were obtained. Four faculty members (three from the main university campus and one from a regional campus) were awarded the grants. These faculty members represented a variety of departments, including science, math, and engineering; arts and sciences, including art education and foreign language education; and the college of education, including special education. Participating faculty would distribute the clickers to students at the beginning of each class session and collect them at the end. Grant recipients were to introduce the SRS into their respective disciplines and observe how students benefited from using the devices.

The associate director of technology pedagogy at the CTE led the group by obtaining and disseminating the devices, explaining grant requirements, conducting group meetings, and ensuring the use of the devices. Through a series of meetings at the CTE, the grant recipients shared best practices, ideas for implementation, pros and cons of the technology, and students’ perceptions of the effectiveness of using the SRS. At the end of the term, faculty submitted summary reports that described their use of the

devices in classroom activities and documented best practices. Participating faculty also distributed a survey to students to gauge their perceptions about the effectiveness of the SRS in their courses; 64 out of 74 students completed the survey.

Research Findings

Each faculty member participating in the SRS technology grant reported embedding questions within PowerPoint presentations as a means of “pre-lecture” or “mid-lecture” checks. These questions allowed for a quick assessment of the general understanding of the material. To encourage students to read the supporting textbook material before coming to class, one faculty member used the devices to conduct brief formative assessments with objective questions at the beginning of each class session. Formative assessments were also used to help outline and determine the direction of the lecture and course.

Faculty reported using the clickers daily, citing these as the top four uses:

- Encourage classroom participation
- Facilitate group discussion
- Assess students’ mastery of content
- Help students learn new terms

In the summary reports submitted at the conclusion of the study, each faculty member described a positive experience with the SRS and indicated they plan to use the technology in future courses. The faculty member in the science discipline reported using the SRS in all but two of his lectures, and in both of those cases the students expressed disappointment about not using the clickers.

All faculty reported an improvement in class discussion and participation. According to one faculty member, the immediate feedback provided through the SRS technology motivated students to read more thoroughly before quizzes because they were able to assess their own progress in comparison to others’ progress. This faculty member said, “Students did better than they have ever done in my classes.”

Faculty distributed a survey to students involved in the project and asked them to rate the effectiveness of the use of the iClickers in nine areas, on a scale from “very effective” to “very ineffective,” and to assign an overall rating for the devices. Results of the survey indicated overwhelmingly positive perceptions about the benefits that the SRS technology had for engagement (see Table 1). In particular, more than 80% of the students said clickers were effective or very effective for all of the benefits discussed in the survey with the exception of peer instruction and student presentation, for which a large percentage of students responded “not applicable.”

Table 1. Student Perceptions of Effectiveness of Clickers

| | Very Effective | Effective | Somewhat Effective | Not Effective | Very Ineffective | Not Applicable |
|-----------------------------------|-----------------------|------------------|---------------------------|----------------------|-------------------------|-----------------------|
| Attendance | 70% | 11% | 5% | 0% | 0% | 14% |
| Engage Students | 77% | 20% | 3% | 0% | 0% | 0% |
| Feedback from Instructor | 69% | 25% | 5% | 2% | 0% | 0% |
| Increase Class Discussion | 63% | 28% | 9% | 0% | 0% | 0% |
| Increase Student Learning | 72% | 20% | 8% | 0% | 0% | 0% |
| Learn New Terms | 59% | 25% | 9% | 3% | 0% | 3% |
| Quiz/Test Format | 75% | 14% | 6% | 3% | 0% | 2% |
| Peer Instruction | 28% | 13% | 13% | 2% | 0% | 44% |
| Student Presentations | 14% | 9% | 3% | 5% | 0% | 67% |
| Overall Rating of iClicker | 73% | 20% | 5% | 0% | 0% | 0% |

The survey also asked students to share what they believed worked well and what were the challenges with the SRS. The six themes that emerged from comments about what worked well, in order of frequency mentioned, were:

- Student engagement
- Immediate feedback
- Anonymity
- Increased understanding
- Quick method for taking attendance
- Improved faculty presentations

Students said engagement increased due to hands-on interaction, which stimulated class discussion and kept students focused, engaged, and alert. Immediate feedback was provided through quizzes in a quick and easy format that also provided students with an opportunity to answer anonymously. These options led to a better understanding of course material. Students noted that faculty presentations improved because questions were embedded into the lecture.

Two themes emerged from student comments about challenges they encountered:

- Response time
- Equipment functioning

Students said faculty typically only provided 30 seconds to respond to questions, which was not enough time. Such a time limit for responses is optional and can be set to whatever amount of time the instructor deems appropriate. The concerns about

equipment functioning revolved around battery life, having to register the devices (if the instructor wanted to track students' answers), and not accidentally turning it off. Many students responded that there were no challenges, however, or that once they used the devices a few times, any challenges were diminished or eliminated.

Issues and Drawbacks

A 2007 study suggested that the success of an SRS depends on how students respond to the technology.¹⁴ Students who don't welcome the responsibility of being an active participant in the classroom might prefer a more passive lecture format. In our study, students who appreciated feedback tended to be more positive about the use of the SRS. The SRS itself does not ensure classroom interaction; rather, it is a tool to encourage participation depending on the students' learning style preferences.¹⁵

Although the clickers were easy to implement and operate, some faculty noted challenges with the system's batteries, which would be dead if students neglected to turn off the devices. Other drawbacks included the additional weight faculty had to carry to class (the clickers and the instructor base) and remembering to turn on the base and launch the SRS application.

From a pedagogical standpoint, the limitation of multiple-choice and true/false questions forces faculty to rethink many of their lessons and learning activities. One solution is to word questions in a way that leads to further discussion to engage students in critical thinking. Alternatively, faculty can use opinion questions to seed class discussion. This provides an opportunity for faculty to think critically about the questions they ask and tends to result in the development of better questions.

Another drawback is that using an SRS in the same way every day can become monotonous. Instructors should be prepared to implement clickers for different purposes throughout the semester—for example, for pre-, during, and post-discussion; quizzes; competition between groups; student-generated questions; and student presentations.

Students enlightened one professor about some of the mischief they had witnessed in the use of clickers for courses not included in this study in which students had their own clickers. According to students, some in the class would bring other students' clickers to class, allowing absent students to be counted as present. This took place more often in large classes that did not use seating charts. Moreover, if the class included a quiz or other graded SRS activity, the stand-in student could simply respond using the devices of non-present students. One student said she once saw a peer with six clickers.

Recommendations and Best Practices

Several SRS best practices emerged from this study:

- Review material from the previous day.
- Evaluate what students retained from the previously assigned reading.
- Assess opinions regarding course content.

- Help students understand and define new terminology.
- Train students to write their own SRS questions during their oral presentations.

Several faculty used the SRS to review material or content from readings. When the SRS was used at the beginning of class to review material from previous classes, students' answers helped the instructor assess what students remembered, how well they grasped the material, and what needed to be reviewed further. When using an SRS to discuss new content and to measure what students remembered from their required reading for homework, the results illustrated what they had learned from the reading and what the instructor needed to go over in class.

This method also served as motivation for students. There was an added incentive for students to be accountable for the assigned reading because they knew questions would have to be answered the next day prior to the class discussion. As a result, class meetings were more efficient. If students answered the pre-lecture questions correctly, less time was spent discussing their reading and more time was devoted to engaging in hands-on activities to increase learning. In this way, the SRS put students more in control of their own learning and the classroom.

Whenever most students answered a question incorrectly, the instructor spent more time reviewing this topic and occasionally gave students time to look back at the reading with a partner to find the correct answer. When students were assigned to answer a question in a group, using the SRS was a useful way to know when everyone was finished. As soon as all the answers appeared on the screen, discussion could commence.

In addition to answering questions, some faculty provided students with the opportunity to write their own SRS questions. This gave students the opportunity to develop multiple-choice questions and use the SRS from the teacher's perspective. Students could be responsible for writing questions for each class and e-mail them to the instructor prior to the class meeting for inclusion in the presentation.

Research indicates that clickers are often deemed most effective in larger, lecture-style courses; however, they can also be beneficial in smaller classes. The class sizes in our study ranged from a low of 7 students to a high of just 21. Even for students in the smallest class, using the SRS encouraged involvement from all students—because the class could immediately see how many people answered each question, students who normally might not contribute felt more compelled to participate.

What It Means to Higher Education

Research tells us that engaged students are successful students and that an SRS can increase engagement by encouraging students to take a more active role in their learning. SRS technology provides immediate feedback to questions asked in class and can influence class participation, stimulate class discussion, and encourage higher rates of student participation and attendance.

In the SRS project at the University of South Carolina, faculty described a positive experience when integrating SRS technology into their instructional activities, and students perceived the technology as a beneficial tool in learning course content. Each faculty member involved in the project expressed an interest in using SRS technology in future courses. Our findings echo those of a study of student response systems at the University of Wisconsin, in which the authors wrote, “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.”¹⁶

Beyond the direct impacts that SRS tools can have on an individual course, the technology can be part of a larger evolution of teaching and learning in higher education, moving away from traditional, lecture-style instruction to a model in which students play as large a role in guiding their learning as does the instructor. For example, faculty in our study noted that using an SRS as a component of student presentations provides an opportunity for students to think about how well the audience understands the material being presented. Having students think about formative feedback in this way can result in their developing a stronger grasp of the material they are trying to share and how it will be understood by others.

Students who see themselves as equal participants in their learning—and who expect to be held accountable through clicker activities for readings and other assignments—are more likely to attend class and to show up prepared. Class attendance can suffer when students believe they can get everything they need from a textbook or basic class discussion. An SRS helps reverse that dynamic, encouraging students to view class sessions as their opportunity to indicate what they understand and what puzzles them. This can lead to the virtuous circle of active learning in which students and instructors work together to maximize student learning.

At the same time, providing a means to show “in real time” what students are learning gives faculty new opportunities to evaluate the effectiveness of individual learning activities or specific readings. Rather than making inferences about which lessons “worked” and which didn’t based on exam results or student projects, faculty can get direct, immediate feedback about discrete learning activities and make continual adjustments to improve not just the learning in that course but also in the same course taught later.

Faculty development programs can capitalize on technology tools, such as an SRS, to help implement techniques for engaging students even outside the use of clickers. Thinking about learning activities in the context of an SRS and seeing the results quickly and directly can lead to a more refined understanding of the effectiveness of a range of other active-learning strategies.

Key Questions to Ask

- What are the variables for different SRS systems, and how will your institution prioritize those options?

- Which courses at your institution stand to reap the greatest benefit from clickers?
- How will the use of clickers change faculty teaching habits, and what are the best approaches to guiding faculty through this evolution?
- How can your institution best minimize the drawbacks of clicker use?
- By what standards will your institution consider clickers to be an effective component of classroom instruction? What metrics will be used to evaluate a clicker program?

Where to Learn More

- Beatty, Ian. "Transforming Student Learning with Classroom Communication Systems" (Research Bulletin 3, 2004). Boulder, CO: EDUCAUSE Center for Applied Research, 2004, <http://net.educause.edu/ir/library/pdf/ERB0403.pdf>.
- Briggs, Charlotte L., and Deborah Keyek-Franssen. "Clickers and CATs: Using Learner Response Systems for Formative Assessments in the Classroom." *EDUCAUSE Quarterly* 33, no. 4 (2001), <http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazin/eVolum/ClickersandCATsUsingLearnerRes/219138>.
- Bruff, Derek. "Classroom Response Systems." 2008. http://www.vanderbilt.edu/cft/resources/teaching_resources/technology/crs.htm.
- Davis, Barbara. *Tools for Teaching*. San Francisco: Jossey-Bass, 1993.
- Geske, Joel. "Overcoming the Drawbacks of the Large Lecture Class." *College Teaching* 40, no. 4 (1992). <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=9607291590>.
- Guaci, Sally A., Arianne M. Dantas, David A. Williams, and Robert E. Kemm. "Promoting Student-Centered Active Learning in Lectures with a Personal Response System." *Advances in Physiology Education* 33, no. 1 (2009). <http://advan.physiology.org/cgi/content/full/33/1/60>.
- Guthrie, Rand W., and Anna Carlin. "Waking the Dead: Using Interactive Technology to Engage Passive Listeners in the Classroom." Proceedings of the Tenth Americas Conference on Information Systems, New York, 2004, http://www.mhhe.com/cps/docs/CPSWP_WakindDead082003.pdf.
- Guy, Sandra. "Sometimes a Bright Idea Just Clicks." *Chicago Sun Times*, Sci-Tech Scene, February 28, 2007.
- Hatch, Jay, Murray Jenson, and Randy Moore. "Manna from Heaven or 'Clickers' from Hell?: Experiences with an Electronic Response System." *Journal of College Science Teaching* 36, no. 7 (2005).

- Herreid, Clyde Freeman. "Clicker Cases: Introducing Case Study Teaching into Large Classrooms." *Journal of College Science Teaching* 36, no. 2. (October 2006).
- Johnson, David, and Scott McLeod, "Get Answers: Using Student Response Systems to See Students' Thinking." *Learning & Leading with Technology* 32, no. 4, (2004–2005).
- Lincoln, Douglas J. "Teaching with Clickers in the Large-Size Principles of Marketing Class." *Marketing Education Review* 18, no. 1 (2008).
- Newmann, Fred M., Helen M. Marks, and Adam Gamoran. "Authentic Pedagogy and Student Performance." *American Journal of Education* 104, no. 4 (August 1996), <http://www.jstor.org/stable/1085433>.
- Preis, Michael, and G. M. Kellar. "The Effects of Using PRDs on Students: Best Practices, Observations, and Recommendations." Special session on the use of the personal response devices (clickers) in marketing, presented at the meeting of the American Marketing Association Marketing Educator's Conference, Washington D.C., August 2007.
- Trees, April R., and Michele H. 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, no. 1 (2007).

Endnotes

1. Barbara Davis, *Tools for Teaching* (San Francisco: Jossey-Bass, 1993).
2. Rand W. Guthrie and Anna Carlin, "Waking the Dead: Using Interactive Technology to Engage Passive Listeners in the Classroom," proceedings of the Tenth Americas Conference on Information Systems, New York, 2004, http://www.mhhe.com/cps/docs/CPSWP_WakindDead082003.pdf.
3. Charlotte L. Briggs and Deborah Keyek-Franssen, "Clickers and CATs: Using Learner Response Systems for Formative Assessments in the Classroom," *EDUCAUSE Quarterly* 33, no. 4 (2001), <http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/ClickersandCATsUsingLearnerRes/219138>.
4. Joel Geske, "Overcoming the Drawbacks of the Large Lecture Class," *College Teaching* 40, no. 4 (1992): 151–155, <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=9607291590>.
5. April R. Trees and Michele H. 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, no. 1 (2007): 21–40.
6. Douglas J. Lincoln, "Teaching with Clickers in the Large-Size Principles of Marketing Class," *Marketing Education Review* 18, no. 1 (2008): 39–45.
7. Derek Bruff, "Classroom Response Systems," (2008), http://www.vanderbilt.edu/cft/resources/teaching_resources/technology/crs.htm.
8. Sandra Guy, "Sometimes a Bright Idea Just Clicks," *Chicago Sun Times*, Sci-Tech Scene, February 28, 2007, 60.
9. Fred M. Newmann, Helen M. Marks, and Adam Gamoran, "Authentic Pedagogy and Student Performance," *American Journal of Education* 104, no. 4 (August 1996): 290–312, <http://www.jstor.org/stable/1085433>.

10. Ian Beatty, "Transforming Student Learning with Classroom Communication Systems" (Research Bulletin 3, 2004) (Boulder, CO: EDUCAUSE Center for Applied Research, 2004): 5, <http://net.educause.edu/ir/library/pdf/ERB0403.pdf>.
11. David Johnson and Scott McLeod, "Get Answers: Using Student Response Systems to See Students' Thinking," *Learning & Leading with Technology* 32, no. 4, (2004–2005): 18–23.
12. Michael Preis and G. M. Kellar, "The Effects of Using PRDs on Students: Best Practices, Observations, and Recommendations," special session on the use of the personal response devices (clickers) in marketing, presented at the meeting of the American Marketing Association Marketing Educator's Conference, Washington D.C., August 2007.
13. Clyde Freeman Herreid, "Clicker Cases: Introducing Case Study Teaching into Large Classrooms," *Journal of College Science Teaching* 36, no. 2. (October 2006): 42–46.
14. Trees and Jackson, "The Learning Environment in Clicker Classrooms."
15. Ibid.
16. Robert Kaleta and Tanya Joosten, "Student Response Systems: A University of Wisconsin System Study of Clickers," (Research Bulletin 10, 2007) (Boulder, CO: EDUCAUSE Center for Applied Research, 2007): 9, <http://net.educause.edu/ir/library/pdf/ERB0710.pdf>.

About the Authors

At the University of South Carolina, Tena B. Crews (tcrews@mailbox.sc.edu) is Professor in the College of Hospitality, Retail and Sport Management, Integrated Information Technology Program; Lara Ducate (ducate@sc.edu) is Associate Professor of Languages, Literatures and Cultures; and Karen Heid (heid@sc.edu) is Assistant Professor of Art Education. Stephen T. Bishoff (steveb@uscsu.edu) is Associate Professor in the College of Science, Math & Engineering at the University of South Carolina–Sumter. Jeanna Marie Rathel (jrathel@lcsd.k12.sc.us) is Special Educator in the Lancaster County School District.

Citation for This Work

Crews, Tena B., Lara Ducate, Jeanna Marie Rathel, Karen Heid, and Stephen T. Bishoff. "Clickers in the Classroom: Transforming Students into Active Learners." (Research Bulletin 9, 2011). Boulder, CO: EDUCAUSE Center for Applied Research, 2011, available from <http://www.educause.edu/ecar>.

Copyright

Copyright 2011 EDUCAUSE and Tena B. Crews, Lara Ducate, Jeanna Marie Rathel, Karen Heid, and Stephen T. Bishoff. All rights reserved. This ECAR research bulletin is proprietary and intended for use only by subscribers. Reproduction, or distribution of ECAR research bulletins to those not formally affiliated with the subscribing organization, is strictly prohibited unless prior permission is granted by EDUCAUSE and the authors.