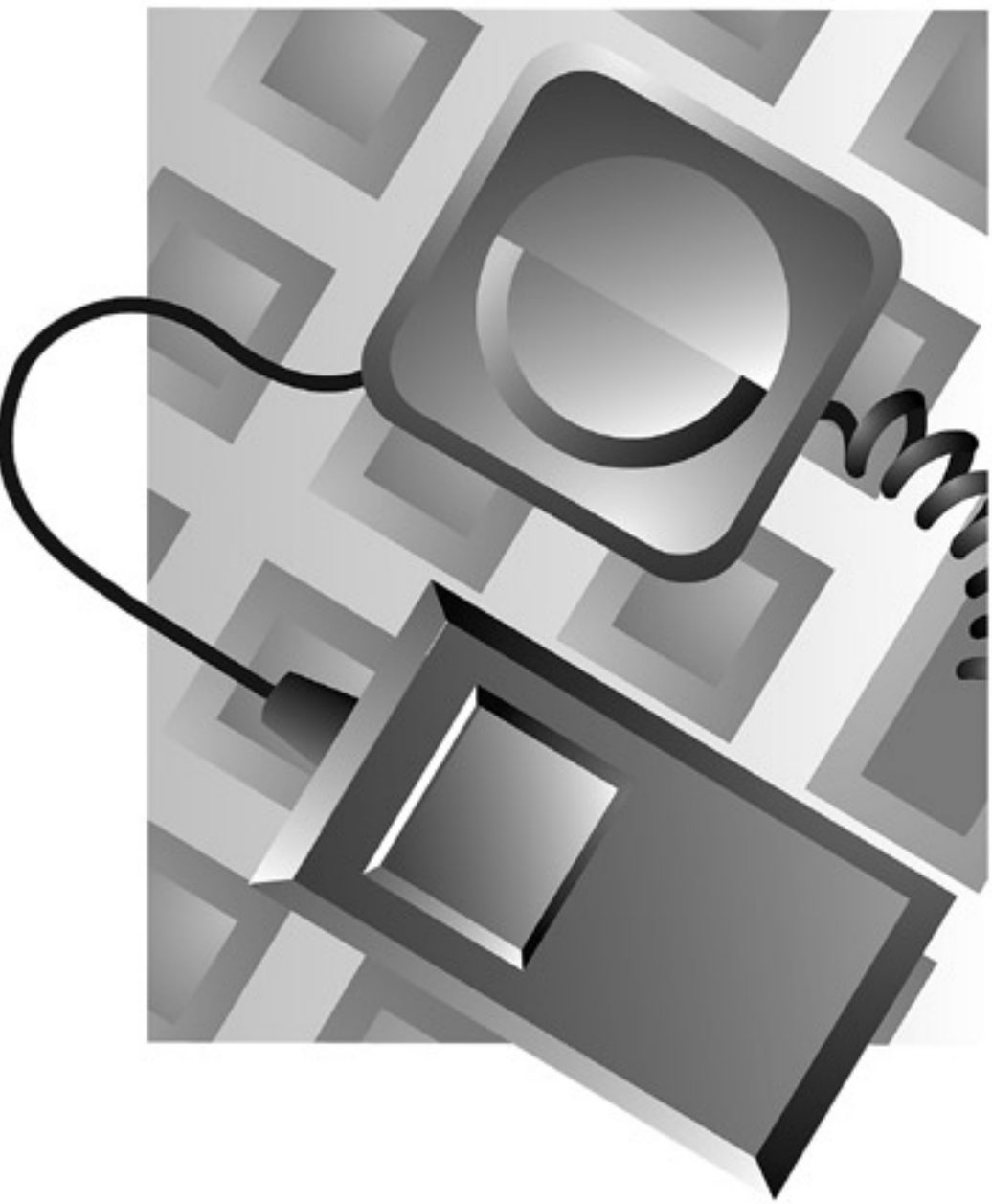
Clickers in the Classroom: An Active Learning Approach

Further research will determine whether clickers complement or surpass other active learning approaches in improving learning outcomes

By **Margie Martyn**



Current research describes the benefits of active learning approaches. Clickers, or student response systems, are a technology used to promote active learning. Most research on the benefits of using clickers in the classroom has shown that students become engaged and enjoy using them. However, research on learning outcomes has only compared the use of clickers to traditional lecture methods. Although learning outcomes are higher when using clickers, the question is whether the clickers or the active learning pedagogies are the cause. For this reason, I conducted a study that compared learning outcomes resulting from the use of clickers versus another active learning method—class discussion. Even though both techniques employ active learning, would using clickers increase learning outcomes more than another active learning approach? Two key features distinguish clicker use:

- Clickers provide a mechanism for students to participate anonymously.
- Clickers integrate a "game approach" that may engage students more than traditional class discussion.

The study also investigated students' perceptions of their learning using clickers versus classroom discussion.

Active Learning

The benefits of active learning are widely acclaimed in higher education. According to Guthrie and Carlin,[1] modern students are primarily active learners, and lecture courses may be

increasingly out of touch with how students engage their world. Chickering and Gamson,[2] early proponents of active learning, designated "encourage active learning" as one of seven principles of good practice in higher education.

A relatively new technology, clickers offer one approach to employing active learning in the classroom. They are more formally denoted as student response systems (SRS), audience response systems (ARS), or personal response systems (PRS).[3]

Johnson[4] described how clickers address three of Chickering and Gamson's seven principles for good practice in undergraduate education. Clickers help instructors

- actively engage students during the entire class period,
- gauge their level of understanding of the material being presented, and
- provide prompt feedback to student questions.

Beatty explained why clickers help students actively engage in the learning process. He wrote that this engagement helps students

> …develop a more solid, integrated, useful understanding of concepts and their interrelationships and applicability. A concerted focus on understanding rather than recall, and on reasoning rather than answers, bolsters the effect.[5]

With clickers, students have an input device that lets them express their views in complete anonymity, and the cumulative view of the class appears on a public screen. Each input device is numbered, however, so the instructor can download responses for recordkeeping after the class session ends.

Although these systems are becoming increasingly popular in higher education, most research has targeted their affective benefits, which include greater student engagement, increased student interest, and heightened discussion and interactivity. According to West,[6] however, past studies on learning outcomes suggest that better learning outcomes result from changes in pedagogical focus—from passive to active learning—and not from use of a specific technology or technique.

The anonymity of responding with a clicker guarantees near or total participation

Clickers can provide added value, however, when compared to some active learning methods such as class discussion. In a normal class discussion situation, only one or two students have the opportunity to answer a question. Even if the answer is correct, the instructor has no way to gauge if the other students knew the correct answer. A student who is unsure of the correct answer may be unwilling to take the public risk of being incorrect. One of the best features of an SRS is that it allows students to provide input without fear of public humiliation and without having to worry about more vocal students dominating the discussion. Even in small-enrollment classes, many students are reluctant to respond to faculty questions; the anonymity of responding with a clicker guarantees near or total participation. Johnson described this benefit:

> First, many students are hesitant to respond to an answer until they know how others will respond. We have all observed students glancing around the room when a question is asked, gauging the number of hands that have been raised until a "safe" number are in the air for them to add their own. Therefore, the anonymity that an electronic system provides allows students to respond in a safe manner, which encourages them to take risks with their responses. Second, it is difficult, if not impossible to ask multi-answer questions with a simple show of hands. You can imagine yourself saying "Okay, put up your right hand for A, left hand for B, both hands for C, and stand up for D."[7]

Another benefit of clickers over traditional active learning methods is that they follow the principles of game-based learning. Students of the twenty-first century have grown up using computer games for learning and entertainment.

My study isolated the effects of clickers by comparing two classes that used clickers ($n = 45$) with two classes that used class discussion ($n = 47$). Although both methods involved active learning, clickers had the additional benefits described above. The study investigated whether these additional benefits resulted in higher learning outcomes.

Learning outcomes were measured by taking the score on the comprehensive final exam at the end of the semester. In addition, a pretest was given to determine if any statistically significant differences existed between the groups at the beginning of the study.

The study also compared student perceptions about their learning after using one of the two active learning techniques: clickers or class discussion. All four classes were taught in the same semester (fall 2006), had the same instructor, and used the same textbooks, learning materials, and assessments.

The study took place at a small, liberal arts college in the Midwestern United States. Enrollment at the college includes approximately 2,900 full-time undergraduate day students, 800 evening and weekend adult nontraditional learners, and 600 graduate students from across the United States and more than 20 foreign countries.

Participants in this study included 92 students in four sections of an introductory computer information systems class. The course involved general computer literacy and appealed to a wide range of majors. Two sections used clickers, and two sections used class discus-

Table 1

Study Participants

Used clickers	Class 1 *n* = 22	Class 2 *n* = 23	Total Using Clickers *n* = 45
Used class discussion	Class 3 *n* = 24	Class 4 *n* = 23	Total Using Discussion *n* = 47

Table 2

Pretest Score

Group	Average Pretest Score
Used Clickers (*n* = 45)	49.18
Used Class Discussion (*n* = 47)	51.72

sion. The majority of participants were traditional-aged learners (18–22 years old) who attended the institution on a full-time basis. See Table 1.

During the first class session, I administered the pretest. On the last day of class, I administered the final exam and the perception survey to the students.

As Table 2 illustrates, the pretest scores for all the groups had similar means of approximately 50 percent.

When calculating an analysis of variance between the pretest scores of those students using clickers and those who did not, no statistically significant difference occurred in the pretest scores between the two groups $F(1, 90) = 1.647$, $p < .203$).

All the classes met twice a week for 75 minutes for the course lecture and question sessions. Turning Point Technologies software was used to collect clicker responses. The same PowerPoint presentation, including the same questions, was used for the sections participating in class discussion. The only difference was that the students using class discussion needed to raise their hands to respond, so their responses were not anonymous. Clickers were implemented based on recommendations for best practices from Robertson, Duncan, and Turning Point Technologies[8] (see the sidebar).

Evaluation

Evaluation of the study results focused on student learning outcomes and students' perceptions of them.

Student Learning Outcomes

The mean for the group using clickers was 85.80 (SD = 8.98). For the group using discussion, the mean was 87.19 (SD = 7.58). When performing an analysis of variance between the posttest scores of students using clickers and those who had not, there was no statistically significant difference: $F(1, 90) = .634$, $p < .428$.

Best Practices for Implementing Clickers in the Classroom*

1. Keep slides short to optimize legibility.
2. Keep the number of answer options to five.
3. Do not make the questions overly complex.
4. Keep voting straightforward—systems allow complex branching, but keep it simple.
5. Allow sufficient time for students to answer questions. Some general guidelines:
   - Classes of fewer than 30 students: 15–20 seconds per question
   - Classes of 30 to 100 students: 30 seconds per question
   - Classes of more than 100 students: 1 minute per question
6. Allow time for discussion between questions.
7. Encourage active discussion with the audience.
8. Do not ask too many questions; use them for the key points.
9. Position the questions at periodic intervals throughout the presentation.
10. Include an "answer now" prompt to differentiate between lecture slides and interactive polling slides.
11. Use a "correct answer" indicator to visually identify the appropriate answer.
12. Include a "response grid" so that students know their responses have registered.
13. Increase responsiveness by using a "countdown timer" that will close polling after a set amount of time.
14. Test the system in the proposed location to identify technical issues (lighting, signal interference, etc.)
15. On the actual day of the session, allow time to set out clickers and start system.
16. Rehearse actual presentation to make sure it will run smoothly.
17. Provide clear instructions on how to use the clickers to the audience.
18. Do not overuse the system or it will lose its "engagement" potential.

*Tips 1–5, 14–16, and 18 came from Robertson; tips 6–9 and 17 from Duncan; and tips 10–13 from Turning Point Technologies.

Table 3

Perception Survey Results*

Survey Question	Used Clicker (*n* = 45) Mean	Used Class Discussion (*n* = 47) Mean
Participation with clickers (or class discussion) improved my grade in the course.	3.60	3.20
Participation with clickers (or class discussion) improved my understanding of the subject content.	4.03	3.61
Participation with clickers (or class discussion) increased my feeling of belonging in this course.	3.78	3.48
Participation with clickers (or class discussion) increased my interaction with the instructor.	4.15	3.62
Participation with clickers (or class discussion) increased my interaction with other students.	3.45	3.17
I enjoyed participation with clickers (or class discussion).	4.14	3.93
I would recommend using clickers (or class discussion) again in this course.	4.12	4.05

*Strongly Disagree = 1; Disagree = 2; Unsure = 3; Agree = 4; Strongly Agree = 5

Perceptions of Student Learning Outcomes

Based on the survey results, student perceptions of using clickers or class discussion appear in Table 3. The seven-question perception survey, which used a scale from 1 (strongly disagree) to 5 (strongly agree), was completed by all 92 participants. Although no statistically significant differences occurred, the mean scores were consistently higher for students who had used clickers.

Recommendations for Further Research

Despite the lack of statistically significant results in this study, the perception survey data show that students perceive value in the use of clickers and would recommend their use in future classes. Contrary to expectations, learning outcomes of students using clickers did not improve more than the traditional active learning approach of using class discussion. Perhaps the value of the active learning pedagogy outshadowed the benefit of using clickers.

Another explanation might be the instructor's inexperience—this was the first time I had used clickers in the classroom. More research is needed to discover if clicker technology can enhance the benefit of using traditional active learning approaches. As the body of research grows, the list of best practices will also expand as instructors develop new strategies to integrate clicker technology into their teaching practices.

The best way to help instructors is to provide mentoring and support from other instructors using clicker systems. I plan to share all the course lecture presentations using clickers designed for this study with other instructors who teach the same course. Other faculty members can improve upon the learning materials rather than starting from scratch. According to Beatty,

> Sharing questions between instructors, or even providing a library or model curriculum of predesigned question sets, can make a big difference to a new instructor trying to climb a steep learning curve.[9]

This type of collaboration will expedite future improvements, and further research will determine their value in active learning. *e*

Endnotes

1. R. W. Guthrie and A. 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, August 2004.
2. A. Chickering and Z. Gamson, "Seven Principles for Good Practice in Undergraduate Education," *AAHE Bulletin*, No. 39, 1987, pp. 3–7.
3. C. Johnson, "Clickers in Your Classroom," *Wakonse-Arizona E-Newsletter*, Vol. 3, No. 1, 2004, <http://clte.asu.edu/wakonse/ENewsletter/studentresponse_idea.htm> (retrieved January 24, 2007).
4. Ibid.
5. I. Beatty, "Transforming Student Learning with Classroom Communication Systems" (Boulder, Colo.: EDUCAUSE Center for Applied Research, Issue 3, 2004), p. 5, <http://www.educause.edu/LibraryDetailPage/666?ID=ERB0403>.
6. J. West, "Learning Outcomes Related to the Use of Personal Response Systems in Large Science Courses," *Academic Commons*, December 9, 2005, <http://www.academiccommons.org/commons/review/west-polling-technology> (retrieved January 24, 2007).
7. Johnson, op. cit., para. 8.
8. L. J. Robertson, "Twelve Tips for Using a Computerized Interactive Audience Response System," *Medical Teacher*, Vol. 22, No. 3, 2000, pp. 237–239; D. Duncan, *Clickers in the Classroom* (Upper Saddle, N.J.: Addison-Wesley, 2005); and Turning Technologies Audience Response Systems, Higher Education Best Practices, <http://www.turningtechnologies.com/highereducationinteractivelearning/bestpractices.cfm> (retrieved January 24, 2007).
9. Beatty, op. cit., pp. 6–7.

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