Clickers in the Classroom

By Kathy Kenwright

Is there an alternative to traditional lectures? The Clinical Laboratory Science (CLS) department at the University of Tennessee Health Science Center is investigating the use of audience response systems (ARS) in its lecture style classes. ARS, or clickers, as they are more commonly called, are wireless hand held devices about the size of a small calculator (see Figure 1). Students may use clickers in class to: answer questions in the form of quizzes or self assessment, perform instructor or course evaluations, and/or record attendance. Clickers have been shown to improve attendance and increase participation. Research on student grade improvement is ambiguous. The best application of clickers appears to be the immediate feedback assessment provided to the instructor and the students.

Figure 1. A TurningPoint clicker

Often the content of lectures in CLS classes overlaps among the disciplines. The instructor knows that a concept has been covered in another class, but does not know if the students remember the concepts well enough to skip over it. An ARS is a good way to assess students' existing knowledge or to activate prior knowledge to "make it available in working memory for learning" (Reiser & Dempsey, 2007, p. 315). In order to learn new material the new content needs to be integrated with existing knowledge (Reiser & Dempsey).

It is sometimes difficult to know who understands the content of a lecture. With the use of audience response systems, or clickers, the instructor knows immediately whether the students understand the concept being discussed (Ribbens, 2007). Immediate feedback gives the instructor an opportunity to review the topic or save time and move on to the next topic. The teacher has to be flexible enough to redirect a lecture to meet the changing needs of the class. Stuart, Brown, and Draper (2004) refer to this as "contingent teaching."

Students also know immediately how their level of understanding compares to their classmates. Sometimes students think no one else in the class understands so it must be the professor's fault. When they see that 80% of the class answered the question correctly but they did not, it is motivation to study more. The class does not know who answered a question incorrectly.

Clickers can be used for formative evaluation that occurs throughout the course, providing information to students and the instructor about where further learning or teaching needs to occur (Oerman & Gaberson, 2006). ARS can be used for quick in-class quizzes. In-class quizzes can be used as self-assessment for the students,

though some instructors may prefer to count them as a grade. Clickers can also be used as a quick method to quiz students reading assignments, holding students accountable for pre-class preparation (Caldwell, 2007).

Instructors can also use the clickers for summative evaluation at the end of the term. Each clicker has a unique number that can be assigned to individual students. These numbers can be programmed into the ARS software to enable assignment of grades on the quizzes or tests. Some ARS software is able to automatically download students' grades from the quizzes or tests into an electronic learning system.

Cases

Attendance

Several studies show that using ARS increases attendance. Homme, Asay, and Morgenstern (2004) found an increase in attendance of 50% and the increase has been constant for two years. After implementing the use of ARS, Ribbens (2007) reported that attendance was 20% higher than two years earlier. In another study, attendance rose 80-90% when clicker quiz scores counted for more than 15% of the grade (Caldwell, 2007). If using the clickers to record attendance, be aware that students have been known to bring multiple clickers to class to record the attendance of their friends.

Interaction

Lecture-based instruction is the standard delivery format in most clinical laboratory science programs. This passive information delivery fails to engage all students (Hoag, Lillie, & Hoppe, 2005). Clinical laboratory science students are adult learners. The typical adult student's attention lapses after about 15 minutes into a lecture (Hoag et al.). Using an interactive method such as an ARS is more effective than routine didactic lectures when teaching adults (Homme et al., 2004). The clickers add a sense of camaraderie to the class. The whole class cheers when 100% of the students answer the question correctly.

In a recent study, students reported that they were twice as likely to answer a question if answers were submitted by audience response systems (Caldwell, 2007). Clickers increase students' participation by giving all students an opportunity to answer questions asked by the instructor (Caldwell). Without clickers, the same students often answer the questions week after week, but clickers forced every student to answer (Ribbens, 2007). Miller, Ashar, and Getz (2003) made videotape recordings of lectures with and without ARS. The recordings showed more student–teacher interaction when ARS was used.

Being able to use the clickers anonymously gives the students courage to express themselves even if they think their opinion differs from the lecturer (Uhari, Renko & Soini, 2003). The responses can be quickly calculated and displayed as a bar graph. The students can tell instantly what percent of the class chose each answer. Participants can check their own answers and know immediately how well they are doing compared to their classmates (Miller et al., 2003).

Test Scores

Students often perceive that attending lectures or review sessions using the ARS has a positive effect on their grades. DeBourgh (2008) found that 66% of students surveyed felt that the clickers helped them perform better on tests. Johnson (2005) studied a group of dental students that had used ARS in a dental course. These dental students had participated in a quiz bowl using clickers to respond to multiple choice questions. Johnson reported that 76% of the dental students felt that using the ARS had helped to reinforce concepts learned in class. DeBourgh (2008) and Johnson (2005) did not compare test scores but other researchers have. Reviews are mixed on whether or not clickers improve grades.

Simon and Stahl (2005) conducted a study that compared the short-term knowledge retention of three groups of people who had attended a workshop. Two of the groups took a posttest at the end of the workshop. One group used an audience response system to take the posttest, the second group used a pencil and paper test, and the third group had no posttest. Simon and Stahl found that there were no significant differences in test scores between the three groups when they were tested six months later. The group that used the ARS did score a little higher, but the difference was not statistically significant.

A similar study examined the use of ARS in continuing education seminars for physicians. Miller et al. (2003) surveyed participants from 42 continuing education programs across the country. The speakers who used the ARS system for their lectures received higher scores on their evaluations than those who did not. The physicians who attended the workshops also liked the ARS system. They felt that it helped them stay alert and they liked answering the questions anonymously. Both groups (those using ASR and those not using it) took a posttest at the end of the session. Miller et al. found no significant difference in the test scores between the two groups.

Stein, Challman, and Brueckner (2006) conducted a study with 155 freshmen nursing students. They compared test results of students using ARS technology for review sessions with those who had traditional lecture-style review sessions. Their results showed that the class average on tests was not significantly different between the two groups.

Caldwell (2007) suggests that active engagement increases achievement for some students. The number of students earning A's in a mathematics course increased by almost 5 % when clickers were used and decreased the number of students failing (Caldwell). After using clickers students' grades averaged 8 % higher than the previous year when clickers were not used (Ribbens, 2007). The data from Caldwell and Ribbens studies should be used with caution. Both of those studies compared two different groups of students. There may be other variables influencing the results.

Problems

Time

As with any technology, there are inherent problems with the audience response systems. Time seems to be a

common problem. Researchers heard complaints from users about time spent setting up and taking down the hardware (Stuart et al., 2004) or time spent learning to use the software (Hatch et al., 2005). Designing effective questions can be time consuming (DeBourgh, 2008).

Time spent getting the system set up at the beginning of class was a problem that Stuart et al. (2004) reported. When surveyed, 59 % of the students in their study complained that too much class time was used for set up. In one case the professor had so much material to cover that she felt stressed because it was taking too much time to get things set up (Stuart et al.).

Asking too many questions during the lecture leaves less time to convey important content (Miller et al., 2003). In a curriculum such as the Clinical Laboratory Science program, there is a defined body of knowledge that must be delivered to the students. This type of education is similar to vocational education where the concern is "with the outcomes rather than the process of learning" (Elias & Merriam, 2005, p. 99). These students have to pass national board exams in order to get licensure to work, so it is critical that they are exposed to the didactic material.

Hatch et al. (2005) spent about 20 hours learning how to use the software, whereas Uhari et al. (2003) only needed half a day of training, along with peer support. The learning curve for the software will vary with the faculty member's computer literacy skills, the software package, and vendor support. A typical user can learn the basics of the software in less than an hour, but the more advanced options will take longer to learn. Creating the slides is time consuming, because you cannot simply "cut and paste" from another document.

Expense

Students on a budget will not be happy with the additional expense of buying a clicker. Ribbens' (2007) students complained about the $30 clicker price until they realized that the clickers might help them earn a higher grade. One option is for the program to purchase the clickers and pass them out at the start of class. This works really well and does not take much time if clickers are used anonymously.

Questions

As Stuart et al. (2004) found, one limitation is in the type of questions that can be asked. When one professor tried to used the handsets in a philosophy class, the experience was not good because the questions she used were too subjective. The students did not have enough time to discuss the questions and answers (Stuart et al.).

Different types of questions can be used with clickers depending on the needs of the students. Questions can be prepared ahead of time or they can be spontaneously added during lecture. Of course, if they are added during class the class will be kept waiting while the instructor is typing in the question and answer choices. In 50-minute lecture classes it may not be worth using class time to add spontaneous questions. There is nothing wrong with reverting to an old-fashioned show of hands, or calling on a particular student for an answer.

Ribbens (2007) suggests using simple multiple-choice questions for review sessions or confidence builders. More advanced questions with graphics inserted can also be used to add interest and challenge advanced students. Carefully designed questions can be used to stimulate discussion in the classroom (DeBourgh, 2008).

Uhari et al. (2003) found that questions should be easily and quickly understood and advise not offering more than five multiple-choice answers. Uhari et al. also recommend that more time should be allowed for discussions. If the questions are used for math problems, the next slide in the presentation should show how to solve the math problem, or be prepared to go to the chalkboard and show the class how to solve the problem.

Recommendations

Specific problems will depend on the ARS system chosen. Hardware and software compatibility issues will need to be resolved. If at all possible, buy the most recent version of the equipment and software. For example, buy the newer radiowave frequency rather than the infrared signal that florescent lights interfere with. Hardware requirements will vary with the size of the classroom (TurningTechnologies LLC).

Download the software and develop the questions ahead of time. Practice using the clickers in the lecture room that will be used for the class. A common problem occurs when multiple professors are using clickers that are set to receive different channels. If someone sets the receiver on another channel, the clickers will not be recognized. This is a simple problem to correct but is very frustrating if one is not familiar with the software. If possible, use a laptop computer to develop the questions, then use the same laptop in the classroom; this will prevent technical difficulties with file recognition problems (Stein et al. 2006). Be prepared in case the computer freezes.

Conclusion

Students enjoy using clickers. They are fun and encourage lively discussions in the classroom. Instructors report less sleeping and more alert students (Caldwell, 2007). But when there is a defined body of knowledge that needs to be conveyed to the students, time spent using the clickers needs to be balanced with the time needed to introduce new material. As Uhari et al. (2003) point out, clickers cannot improve a poorly organized lecture.

Clicker technology is definitely worth trying since the monetary cost has dropped dramatically and some of the earlier problems have been eliminated with advances in technology. A few years ago the software cost was several thousand dollars. Now there is no charge for the software. The only cost is $100 for a receiver that plugs into a USB port (see Figure 2) and approximately $30 for each clicker. More research on the use of clickers in the classroom needs to be done in the field of clinical laboratory science to determine if using the clickers in this field improves student learning. Until that is done, clickers should be used judiciously.

Figure 2. TurningPoint USB receiver

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