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ABSTRACT

Clickers are a classroom technology that allows students to provide both categorical and numerical responses to questions during a lecture. The student responses can be tracked, totaled, and scored in various ways to provide feedback to both the students and professors. At a Midwestern University, in the Fall 2007 semester, clickers were integrated into a course titled "Managing in a Digital World." As instructors of the course, we learned much about teaching and clickers through this effort and we highlight our experiences in this discussion.

KEYWORDS

Personal response system, student response system, audience response system, classroom response system, clickers, active learning, collaborative learning, classroom technology, collaboration technology.

INTRODUCTION

"Clickers" are a classroom technology that allows students to provide both categorical and numerical responses to questions that may arise during a lecture (Hall et al. 2005). Clickers are also referred to as personal response systems, student response systems, audience response systems, or classroom response systems. With the use of clickers, student responses can be tracked, totaled, and scored in various ways to provide feedback to both the students and professors (Hall et al. 2005).

At a Midwestern University, in the Fall 2007 semester, clickers were integrated into a course titled "Managing in a Digital World." The course is an undergraduate course, for juniors and seniors, required for all Management Information Systems (MIS) students. While the course includes lectures, it also focuses on the discussion of cases. This class, in which clickers were introduced, had only 16 students enrolled which is considered small by many standards (Lowman 1995). Additionally, during this period one of the two instructors of the course was part of a user group for professors within the university using clickers. Based on information provided by the members of user group, this course was by far the smallest course on campus using clickers in the Fall 2007 semester.

Previous research has studied the implementation and integration of clickers in classes with large numbers of students that traditionally rely on a lecture format (Hauck et al. 2006). The goal of this paper is to present a case study of the implementation and integration of clickers into a class with a small number of students where the format is based on case discussions. The experiences from the instructor perspective will then be presented based on this case. A secondary goal of this research is to assist other instructors in understanding the benefits of clickers as well as provide reflection and insight for those who may be interested in adopting clickers in their smaller classrooms.

The next section presents a background of theories of learning related to the use of clickers in the classroom followed by a presentation of clickers. The following section then describes the case of using clickers in a small classroom with regards to the setting, the technology, and the clicker use. The paper concludes with a discussion of our experiences and concluding remarks.

BACKGROUND

Theories of Learning

Research suggests that educators, students, and employers believe that the integration of technology in classrooms can enhance learning (Alavi 1994). This use of technology in a classroom purposely or inadvertently reflects a model of learning (Leidner et al. 1995). The most commonly mentioned theories of learning include the objectivist model, the constructivist model, the cooperative model, the cognitive information processing model, and the sociocultural model of learning (Leidner et al. 1995). See Table 1 for a summary of the various models.

Theories of Learning	Summary
Objectivist Model	Learners should gain knowledge from teachers with a teacher centered approach
Constructivist Model	Learners should seek out and discover information rather than have it provided to them
Cooperative Model	Learners should learn through interaction, discussion, and information sharing, creating a shared knowledge with the goal of learner participation
Cognitive Information Processing Model	Learners should transform information into knowledge as individuals and then addresses creating an effective individualized learning style
Sociocultural Model	Learners should learn on their own terms

Table 1. Theories of Learning

The objectivist model centers on the concept that teachers should pass on knowledge to learners in a teacher centered approach. Contrary to the objectivist model, the constructivist model focuses on learner centered instruction, suggesting that learners should seek out and discover information rather than have it provided to them. The cooperative model, otherwise referred to as the collaborative model, focuses on the collaboration or interaction of the learners through discussion and information sharing creating a shared knowledge with the goal of learner participation. The cognitive information processing model considers how learners transform information into knowledge as individuals and then addresses creating an effective individualized learning style. Finally, the sociocultural model of learning suggests that students should learn on their own terms.

The use of clicker technology in a classroom reflects the cooperative model, or collaborative model, of learning. Clickers promote classroom *communication, socialization, and participation* with the instructor as the questioner and leader of the discussion. For example, classroom communication is increased between instructors and students through the use of quizzes as students can communicate real-time regarding areas they are having trouble with. Research suggests that this type of collaborative learning is increasing, however traditional testing and exams still dominate instead of technology given exams (Shen et al. 2006). Additionally, clickers address challenges of effective learning, such as active learning, feedback, attention span, and motivation (Hauck et al. 2006).

Clickers

As mentioned above, clickers are a classroom technology that allows students to provide both categorical and numerical (e.g., multi-choice) responses to questions that may come up during a lecture (Hall et al. 2005). With the use of clickers, student responses can be tracked, totaled, and scored in various ways to provide feedback to both the students and professors (Hall et al. 2005). Various forms of clickers or classroom response systems have been used in classrooms since the 1960s (Hall et al. 2005). However, enhancements such as radio-frequency technology and integration with presentation software (e.g., Microsoft PowerPoint®) have made clickers easier to manage (Hauck et al. 2006).

Previous research has suggested that the use of clickers in the classroom allows for a number of benefits (Duncan 2005). For example, the instructors have the ability to: 1) measure what students know prior to teaching (i.e., pre-assessment), 2) measure student attitudes, 3) assess whether students have completed required readings, 4) enable students to confront misconceptions or misunderstandings, 5) increase students material retention, 6) test

student understanding, 7) provide a fair assessment, 8) facilitate discussion and interaction, and 9) increase attendance (Duncan 2005).

In relation to large class sizes previous researchers have identified a number of challenges that can be addressed through the use of clickers (Hauck et al. 2006). For example, instructors of large class sizes have a hard time: 1) taking attendance, 2) establishing seating charts, 3) leading in-class activities, 4) managing group projects, 5) giving in-class surveys (because it is impossible to count all of the raised hands), 6) actively engaging the students, and 7) sustaining student interest (Hauck et al. 2006). This background and previous research was influential in our decision to adopt clickers as a teaching and learning technology in this course. However, instead of using the technology in a large class, it is our intention to present the experiences from a small class perspective.

USING CLICKERS IN A SMALL CLASS

Setting

As a university, there has been increasing interest in using clickers in the classroom. A pilot study of two different clicker systems were conducted in several large classes in other colleges within the university in Spring 2007. In Summer 2007, the instructional technology group for the university provided a recommendation for a standardized classroom response system that would be supported and used on campus. Instructors may choose to use other manufacturers of classroom response systems, but support from the university would be limited to the recommended clicker system.

To show support for those instructors interested in using clickers in the classroom, a campus-wide teaching circle (or user group) was developed. Eighteen people are involved in this community and attend monthly meetings to share best practices, learn about new features, and discover what others are doing with clickers in the classroom.

The course in which clickers was used is entitled "Managing in a Digital World." The purpose of the course is to introduce students interested in information systems and technology to issues associated with management in today's global, digital, and dynamic environment. The course is relatively new to the university, but is a required course for all MIS majors. The course uses selected readings from articles and case studies to illustrate and apply content in a "real world" setting. The class has some lecture-styled format of teaching, but a lot of in class and group discussion is expected from the students as part of the course (i.e., cooperative model of learning). This particular semester was the third offering of the course.

In Fall 2007, two instructors taught the course in a team teaching format. Both instructors attended all lectures, but took turns presenting content, readings, and cases within the course. There were 17 students in the class originally; however, one student dropped our midway through the semester. Class participation was 15% of the students' grade in the course. One-third of this grade was based on performance on quizzes throughout the semester using the clickers.

Clicker Technology and Classroom Use

The clicker technology that was used in this case is from Classroom Performance Systems (CPS)[1]. The system includes handheld key pads for students (i.e., the clicker), a receiver, and software for developing and administering the questions, as well as showing the results. The software allows for integration of the results with Microsoft PowerPoint®, however, that functionality was not used in this case. Most classes on campus that use clickers require that students purchase a clicker for the semester. A key note regarding the clicker technology in this study is that it was provided to the students for free in that they did not have to pay for the individual key pads. The instructors brought the clickers to class for each session and the students were assigned a specific clicker. Students simply picked up their clicker at the beginning of class and returned it at the end of the session.

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[1] http://www.einstruction.com/

We used clickers for several different purposes throughout the semester in our small class. First and foremost, clickers were used for quizzes over the required readings in the course. This served as an incentive for students to read the required material. Second, we used quizzes to review concepts discussed in class. At the end of a topic, a 5-10 question quiz would often be developed to review some of the key concepts. This gave students an idea of important topics and questions that may be seen on future exams. Thirdly, we occasionally asked the students to perform a "self-assessment" of their own skills and abilities. One of the objectives for the course is for students to be able to reflect on their own skills, strengths, and weaknesses. Self-assessments would ask students about their preferences or skills (such as team preferences) and allow them to see how they compared to others in the class. Another use of clickers was the ability for students to reflect on their exam performance. After an exam was given, but prior to its return to the class, students were asked questions about their expected grade for the exam, their study habits, and classroom involvement. This exercise encouraged students to take personal responsibility for their success (or lack of) on exams. Finally, we used the clickers to ask questions that may just arise during the class discussion. Sometimes quick feedback on a question regarding the administration of the course was helpful. Other times, the clickers were used to ask an unplanned question to see if students really understood a concept.

DISCUSSION

As instructors of the course, we learned much about teaching and clickers through the implementation of clickers in a small class. Specifically, our experiences can be grouped into the categories of 1) administration, 2) quizzes, 3) self assessments, 4) test reflections, 5) feedback and participation, and 6) impact on students. The following sections highlight our experiences and relate the experiences to the various aspects of the cooperative model of learning.

Administration

Previous research has suggested that it is important to minimize the cost of the clickers for the students (Hauck et al. 2006). While this may be difficult to do with a large class, we were able to provide the clickers to the students for free because of the small number of students. This ensured that every student had a clicker. Because the instructors kept the clickers and brought them to class each time, students never "forgot" to bring their clicker to class. For attendance, we assigned a clicker number to each of the students and they always picked up their numbered clicker as they entered the classroom.

Another interesting experience in relation to administration, specifically training, is that we found students did not need any instruction on how to use the clickers. This was interesting because when we surveyed the students we found that the majority had no prior clicker experience. This observation this is contradictory from research that found students perceived too much time was spent implementing the response system at the expense of covering course content (Albon et al. 2007). This unexpected experience may have been related to the smaller class size.

The cooperative learning model requires the collaboration between the teacher and the student. By providing the clickers, the instructors ensured the students could participate in learning via the technology. Furthermore, student attendance and overall participation regarding clicker use could easily be tracked by the instructors, again reinforcing the student's role in cooperative learning.

Quizzes

As we mentioned above the clickers were used to evaluate students in regards to the required readings and class concepts. Based on our experiences we found that it is important to be prepared to explain why answers are incorrect because students will pick both correct and incorrect answers. This is similar to previous research which suggested that as instructors we tend to focus on the appropriate response but need to be able to fully explain why other answers are not correct (Hauck et al. 2006). We also found from our experience that clickers provided a benefit in that they gave us the ability to re-test students on same questions regarding concepts or issues that were missed in class in order to ensure that the students really did understand the key concepts.

The clickers provided a benefit for the students and the instructors by providing a realization, or reality check, of how hard some concepts are to grasp. After going over a topic in a lecture and a discussion, we would then have a quiz over it. Sometimes students would miss several questions on clicker quiz. This misunderstanding could be immediately corrected and errant thinking on the issues could be addressed right away instead of after the administration of an assignment or exam.

The clicker quizzes also provided a benefit for the students by allowing them to see what concepts would be important on the exams as well as the style of questions on the exam.

This use of clicker technology reflects the communication aspect of the cooperative or collaborative model of learning. Specifically, classroom communication is increased between the interaction of instructors and students through the use of quizzes as students can communicate real-time regarding areas they are having trouble with.

Self Assessments

Our experience with self assessments in the class allowed us to show students real time information on how they rated against their peers in relation to their skills and abilities. Self assessments worked because of their anonymity. Students did not have to worry about where they fell in relation to one another, but they could compare honestly.

Self assessments in the classroom relates to the cooperative or collaborative model of learning in terms of socialization. For example, classroom socialization was increased between students as they evaluated themselves anonymously. In addition, they could learn more about their peers' views on various self assessment measures. Discussions were then held to compare the viewpoints of the students and create a shared understanding.

Test Reflections

As we mentioned above, we used the clickers for students to reflect on their exam performance. We found that this enabled students to take personal responsibility for the grades they received. It seemed to lessen a lot of questioning or arguing for grades. We came to two realizations based on this practice as well. First of all, we realized that not all students are striving for an "A" in the class. One of the test reflection questions asks: "If I make a(n) _____ on the test, then I will be happy." We found that not all students wanted an "A"; in fact a few would have been happy with a "C". Second, we realized that students were pretty good at predicting their test grade. One question asked: "I think I made a(n) _____ on the exam." In most cases the results were accurate.

This use of clicker technology reflects the communication aspect of the cooperative or collaborative model of learning. Specifically, classroom communication is increased between instructors and students with regards to test performance. In addition, students were able to communicate their expectations and goals for the class, which is helpful for the instructor when creating a learning environment.

Feedback and Participation

We know that clickers provide instant feedback on questions that have been prepared prior to class, but we also found clickers useful for immediate feedback on questions we didn't even know that we wanted to ask before class. One benefit of the clicker system we used is that it enabled us to ask questions whenever something came up. Sometimes this was to take care of administrative issues (e.g., democratic – do you want to do this first or that first today) or sometimes this was just to stimulate more discussion. Also, in terms of participation, we would sometimes use the clickers to call on individuals when students were not volunteering to talk. This was a very democratic way of encouraging collaboration and participation.

This idea of feedback and participation clearly relates to the participation aspect of the cooperative or collaborative model of learning. Student participation could be tracked with the technology and real-time topics for feedback could be addressed.

Impact on Students

The impact on students was unexpected. What we found was that students enjoyed the inclusion of clickers in the class so much that they worked their use into presentations that they had to give. We did offer students the option

to use the clickers in their class presentations and a couple of times students actually did worked this practice into their class presentations. Sometimes these discussion questions were humorous (e.g., one answer was Sanjaya from American Idol) and sometimes they were educational.

This impact on students relates to the socialization aspect of the cooperative or collaborative model of learning. For example, clicker use became a way to increase classroom socialization and students used it as a method to illustrate shared understanding and begin discussions.

CONCLUDING REMARKS

As mentioned above, previous research has studied the implementation and integration of clickers in classes with large numbers of students that traditionally rely on a lecture format (Hauck et al. 2006). Therefore, the goal of this paper was to present a case study of the implementation and integration of clickers into a class with a small number of students where the format is based on case discussions. A secondary goal of this research is to assist instructors in understanding the benefits of clickers as well as provide reflection and insight for those who may be interested in adopting clickers in their smaller classrooms. We know that instructors in large classes appreciate clickers because they 1) allow for students to be more engaged in class, 2) enable the instructor to understand how well the class understands a concept, and 3) ease the burden of taking attendance and grading. However, we found that in a small class, these issues are present, but not to the same degree. Our experiences found many benefits and approaches to using clickers in the classroom, regardless of the class size. Future research should attempt to empirically measure and evaluate the outcomes or performance of students who use clickers compared to those who do not.

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