

EXPERIENCES IN BUSINESS STATISTICS
WITH A CLASSROOM RESPONSE SYSTEM: CLICKERS

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Introduction

The use of electronic classroom response systems, commonly referred to as clickers, is becoming ever more popular. The devices are appropriate for use in many disciplines. As schools adopt student response system technology, teachers are spending a great deal of time and effort developing appropriate questions. This paper will discuss classroom experiences encountered, positive and negative, when introducing statistics students to the uses of a clicker system. In addition, it will also enumerate and discuss a number of available resources such as individuals and groups active in these endeavors. Finally, the authors will discuss their website that includes an on-line library of clicker questions.

Electronic Classroom Response Systems

For this paper, we will use the term electronic classroom response system to mean those where students use individual keypads to anonymously answer questions. Student answers are recorded by a receiver and can be stored on a computer. Some faculty use such systems to take attendance – especially for large sections, some to ask simple questions to check students have pre-read the assigned material, some to check for or develop student understanding of the material, and others for combinations of these. When questions are immediately followed by think-pair-share or whole-class discussion, the purpose of this process is to foster active student learning with the goal to develop students' conceptual understanding.

Current Resources

There are various organizations and researchers who are interested in clicker technology. Some are currently working on introducing clicker technology into statistics as well as other courses. A short list of those we are most familiar with is annotated below. Just for general information, we suggest a visit too see how clickers are portrayed in the news at <http://www.npr.org/templates/story/story.php?storyId=101343866> .

The American Mathematical Association of Two Year Colleges (AMATYC) offered an *AMATYC Summer Institute GAISEing Beyond the Crossroads: Improving Instruction in Introductory Statistics* July 6-10, 2009 based on the GAISE College Report. More information is available at the AMATYC Web site: <http://www.amatyc.org> and at <http://www.causeweb.org/workshop/boulder/>. The GAISE College Report is available at <http://www.amstat.org/education/gaise/GAISECollege.htm>. This report gives the American Statistical Association guidelines for current best practices in statistics education. Their numbers 4 through 6 are especially pertinent here: “4. Foster active learning in the classroom; 5. Use technology for developing conceptual understanding and analyzing data; 6. Use assessments to improve and evaluate student learning.” Numbers four and five were mentioned earlier. For number 6, the distribution of the student responses to the questions on the screen enables students opportunity for self assessment and then self improvement.

A posting to the Mathematical Association of America (MAA) SIGMAASTATED electronic mailing list announced a CAUSE Webinar scheduled for March 10, 2009. Its purpose was “promoting active learning in introduction to statistics using personal response systems (clickers).” J. Kaplan of Michigan State University led the webinar.

T. Murphy presented *Annotated Clicker Questions* at the MAA MathFest in August 2008 based on research by Murphy, C. McKnight, M. Richman, and R. Terry funded by the National Science Foundation’s Course, Curriculum, and Laboratory Improvement Program. More information is available at tjmurphy@ou.edu. Their clicker questions are available at <http://www.ou.edu/statsclickers/clickerQuestions.htm>.

An introduction to Turning Point, a commercial system, can be found at http://www.turningtechnologies.com/?kncgoogle&gclid=CN_jxnNkZkCFQwxawodgm_nVYg. While this is the system currently used by the authors, we have had many frustrating difficulties and are looking at textbooks that utilize other systems. For example, Pearson is currently incorporating clicker questions into the course materials

for *Business Statistics*, 1st edition, by Sharpe, De Veaux, and Velleman. A review of a preliminary copy of one chapter of the clicker questions being developed shows some challenging questions, that would give rise to good class discussion, as well as some trivial attendance, review and understanding questions will be available. More information may be obtained through <http://www.coursecompass.com>. This and other new textbooks are currently under review by fellow faculty members that are pilot testing books during the Summer I 2009 session. With their results, the department's Statistics Committee will decide on the textbook for the Fall 2009 semester based on the summer pilots. Of course, the introductory statistics topics and material are not expected to change.

Clicking with Class

In the fall semester of 2008, the authors began introducing clickers into their sections of Business Statistics I. The research is supported by a Quality Enhancement Program (QEP) grant. This paper describes the experiences of integrating clicker technology using the Turning Point system in particular, but insights from these experiences will have generalized implications.

For the grant, the study was designed to include a control group. A pretest was administered before the sections on descriptive statistics – one of the first topics in the course. The purpose was twofold: a) to find if there was any significant difference in the abilities of the control and clicker groups; and b) to determine the extent of students' prior knowledge of descriptive statistics. In the former, statistical analysis of the data indicated no significant differences in pretest abilities of the classes. In the latter, the results suggest that we need to revise the syllabus with regard to the descriptive statistics topics. Thus the clickers can be utilized not only to give students opportunities for active engagement, but also assist the faculty in refining the course content and presentation through formative evaluation.

We include a description of utilizing the software and hardware, pointing out some of the pitfalls that may be encountered and their resolution. Information regarding software difficulties was sent by the university's Instructional Technology Department shortly after the semester began. Although learning that the class list was not functional, and therefore pre-test answers could not be attributed to particular individuals, general class data was assumed to be accurate. After a software upgrade, the class lists were not updated due to time constraints and the decision to use that fall as a development and pilot semester. Revisions of *A Classroom Response System for Business Statistics: Clicker Pre-test,* though not a very large file, proved to be arduous. The USB port easily heats up even with the program being loaded on the computer hard drive, the

program is slower than was expected, and often the machine would just freeze for several minutes. The freezing was true of the office computer as well as a personal laptop. No matter what the technical difficulties, the positives far outweigh the negatives when using clickers because of the student responses - both physical and verbal. They said they enjoyed using the clickers and they looked far more attentive to the statistics when using the clickers. New hardware and software are continually coming onto the market in improved form, so the technical difficulties are not expected to be a problem for very long.

The Spring 2009 version with sample questions of the statistics pre-test for the introductory business statistics course, presented at the ICTCM 2009 conference, is available through the Library of Clicker Questions website <http://cms.uhd.edu/Faculty/LeveilleN/LibraryofClickerQuestions.htm>, or directly at http://cms.uhd.edu/Faculty/LeveilleN/AClassroomResponseSystemforBusinessStatisticsIntroandPretestversion03122009_files/frame.htm. An example of an attendance question is given in slide 4 as “Which best describes your class standing? 1. Freshman, 2. Sophomore, 3. Junior, 4. Senior, 5. Graduate student, and 6. Other.” Some other types of clickers will take free response answers, but the questions here were all developed in a multiple choice format. An example of a question to check for student understanding is on slide 6 and asks “Which answer best describes the benefits of a good clicker response system? 1. Facilitates active learning, 2. Enables immediate feedback, 3. Protects student confidentiality, and 4. All of the above.” These benefits are discussed on slide 3. The question on slide 19 “Given the shoe sizes 6, 8 ½, 9, 9, 9, 9 ½, 10 ½, 11, 12, 12, 13, 14, which is the best choice for the average shoe size? 1. 10, 2. 12, 3. 9, 4. 9 ¼, 5. None of these” is an example of a question that leads to good class discussion. In particular, the class debates the choice of the mean, median, or mode for the best average in this and then other particular applied situations. As in classes without this technology, developing good questions is always a challenge for teachers.

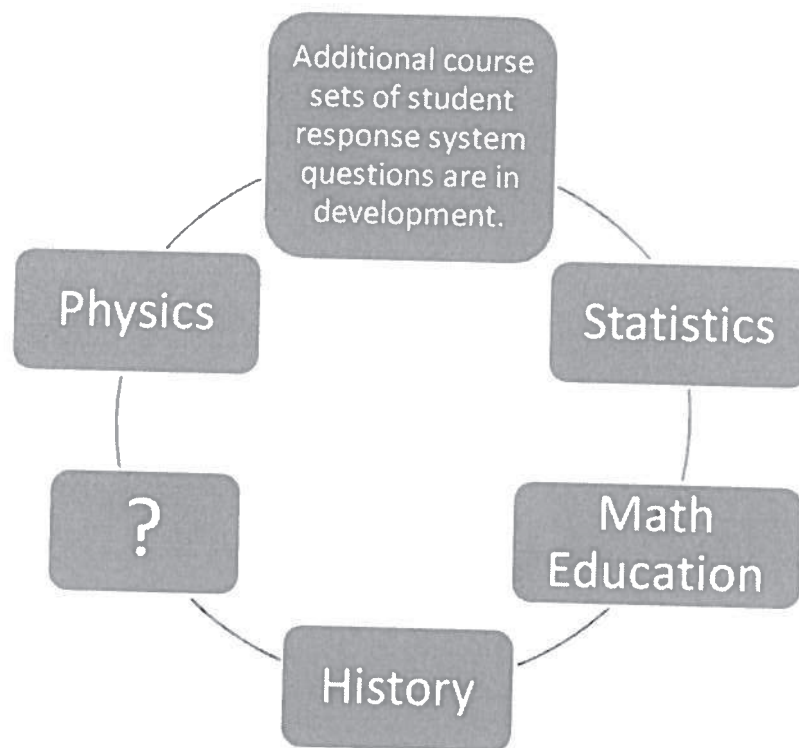
The Spring 2009 version of the post-test, containing the same statistics questions as the pre-test along with their answers indicated in a variety of ways available at an additional second click, is included in the Library of Clicker Questions as, “A Classroom Response System for Business Statistics: Clickers” at http://cms.uhd.edu/Faculty/LeveilleN/AClassroomResponseSystemforBusinessStatisticsversion03122009withanswersindicated+_files/frame.htm. Observations in the Fall 2008 and the Spring 2009 classes reinforced that: a) students are keen on the technology, b) students are very interested and participate 100% when using the clickers, and c) when used to prepare for a test, students need to see the answer indicated to each clicker

question as well as hear the correct response and discussion, otherwise, the correct answer is easily misunderstood or even lost.

Online Library of Clicker Questions

The Library of Clicker Questions is under development (See Figure 1.) and available at <http://cms.uhd.edu/Faculty/LeveilleN/LibraryofClickerQuestions.htm>. The website includes student response system questions for a growing variety of courses. New technology is being purchased by the university's Instructional Technology Department and soon additional response systems and training will become available to the university faculty. We look forward to the challenges and opportunities this will bring to the research.

Figure 1. Library of Clicker Questions



Submissions of your clicker questions are hereby encouraged. Please send questions, or sets of clicker questions, for inclusion following the format on the website to leveillen@uhd.edu. Your suggestions and comments are also welcomed.