The Use of TurningPoint (Clicker) Technology for Formative Assessment in Introductory Statistics

Objectives & Background
Student Response Systems (clickers hereafter) have been successfully utilized in classroom instruction (e.g., Duncan, Liu et al., Martyn). Recognized as an active learning tool they allow students to become more engaged at the time of instruction and can be helpful in stimulating student interest. The feature of anonymously collecting students’ responses lowers common classroom barriers between instructor and students such as the reluctance to answer in-class questions out of fear of being wrong or being judged by peers. If used properly clickers do change students from passive to active learners. Furthermore, they serve as an immediate feedback of the students’ understanding to the instructor that otherwise is impossible.

Clickers lend themselves very easily to classes with less quantitative focus, e.g., humanities, or fact-based sciences that do not center instruction around problem solving methods and skills (e.g., mathematics, statistics, or econometrics). Our main objective focuses on evaluating the effectiveness of clickers for formative assessment in introductory Statistics courses. In simple terms we wish to explore “what works and what does not.”

Clickers have proven their effectiveness undoubtedly at lower levels of learning (following Bloom’s Taxonomy) and we expect similar results in our study. The suitability and effectiveness regarding higher levels of learning however has not been explored extensively and needs to be carefully evaluated.

Results are preliminary, as the Spring semester of 2009 served as pilot study. More concrete hypotheses (see below) including formative assessment are to follow throughout the Fall 2009 and Spring 2010 semesters.

Constructing and Building Knowledge using clickers
In his book Brain Rules, John Medina theorizes that “Memories are so volatile that you have to repeat to remember” and consistent re-exposure to the information is a necessary basis of acquiring knowledge. He argues that short term memory can be created through repetition [Rule #8: Repeat to Remember] and that long-term memory, taking years to consolidate, can only be built through remembering to repeat (Rule #6: Remember to Repeat).

“Repeated exposure to information in specifically timed intervals provides the most powerful way to fix memory into the brain.”

- Clickers clearly provide a powerful tool when trying to implement repetition into classroom instruction.
- Consistent use of clickers at the beginning and end of a class period allow instructors to refer to previously discussed topics while spending very little time instructional time.
- Both students and instructors will be provided with immediate feedback on how much of previously discussed and learned material is still being retained by students at any later stage of the course allowing to assess “cumulative course knowledge”
- This is particularly intriguing in the context of essential and continuously reoccurring topics such as normal distributions or sampling distributions of estimates.

Proposed Research Hypotheses
- What is the best way to incorporate clickers into Introductory Statistics courses?
- How effective is the use of clickers? Can the effect be quantified and is the benefit to student’s understanding of the course material significant?
- Does the use of clickers have an impact on student’s attitudes towards Statistics?
- Does the effective use of clickers depend on class sizes and class topics? What adjustments, if any, are necessary depending on class size and class topics.
- Are clickers suitable for all levels of learning?
- How can clickers effectively be combined with other active and traditional learning tools?

Set-up of Study
- Participants: one section of Stat 101 (Principles of Statistics for General Undergraduates), approx. 100 students
- one section of Stat 226 (Introduction to Business Statistics), approx. 80 students
- classes met three times/week for 50 minutes and twice/week for 75 minutes, respectively
- clickers were provided to students at beginning of each class period – a personal clicker was assigned up to students throughout the entire semester
- students had to register personal clicker in WebCT for grade recording purposes
- clickers were used throughout the entire semester at least once week
- a set of questions was written for each of the topics discussed in class
- questions were written for each of the Types of Bloom’s Taxonomy: (for sample questions see center display)

- Remembering
- Understanding
- Applying
- Analyzing
- Evaluating
- Creating

Preliminary Results and What Did We Learn?
- End of semester surveys indicated positive experience for students (and instructors!)
- Clickers are a valuable learning tool if used appropriately. Use of clickers helps improve classroom participation and student interest in introductory Statistics courses.
- Clicker questions should not used as a replacement of standard forms of knowledge assessment as the level of learning is not the same.
- Type of question (see center display) determines suitability of clicker question, i.e. higher level questions e.g. analyzing, evaluating and creating at first glance to not appear optimal for in-class use due to different work paces of students (“slide times” for faster students should generally be avoided).
- To a certain extent higher level questions, however, can be incorporated in combination with group work, classroom discussions, think-write-pair-share activities.
- Effective use of higher level questions needs to be explored further and incorporation of such questions into on-line learning platform such as WebCT might be more suitable.
- Number of clicker questions per use needs to be limited, students remain attentive for 3-4 questions.
- Further research needs to be done to assess effectiveness of clickers quantitatively (see proposed research).
- Technology is generally reliable but not always.

References