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# Clickers in Large Classes: From Student Perceptions Towards an Understanding of Best Practices

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## Abstract

Handheld wireless transponders, commonly referred to as 'clickers', are similar to standard household remote controls. The present study advances a dialogue in the literature about the specific ways in which clickers may be effectively used in the classroom. The present study was a survey of 516 students who were using clickers in a university course in 2006 or 2007. Student perceptions related to the use of clickers were more favorable in 2007 than in 2006. In addition, responses were more positive among introductory psychology students compared to other participants. Almost half (46%) of the responses to an open-ended question about the 'most helpful' uses of clickers included comments that the clickers had helped in some way with understanding course material, and almost 20% said that the clickers had helped them to prepare for examinations.

**Keywords**: clickers, large classes, transponders, perceptions, best practices

## Introduction

Integrating new technology into a large lecture class can be an interesting journey for instructors and students alike. At the beginning of each term, I work hard at selling students on the potential benefits to using clickers. By the end of the term, most students are very enthusiastic about the clickers. As an example of positive student reactions to clicker technology, consider this quote from a participant in the current study: "The [clicker] unit is a delicious source of knowledge. If I ate technology it would be an extraordinary dessert." It is likely that clickers will continue to grow in popularity, and research on their various pedagogical uses is critical. One basic purpose of the present study was to advance a dialogue in the literature about the specific ways in which clickers may be effectively used in large university classes.

Clickers go by many different names and nicknames including Classroom Feedback Systems, Interactive Response Systems, Zappers, Electronic Voting Systems, Group Process Support Systems, Audience Response Systems, Group Decision Support Systems, Personal Response Systems, Selected Response Systems, Audience Response Technology, and Wireless Transponders. In this paper the term 'clickers' is used to refer to this type of individual student response technology.

The concept of clickers is not new; mechanical feedback systems have been used in classrooms for about 40 years (Abramson, 2006). Modern technology makes these devices more powerful and user-friendly than in the past, however, and advances continue to make clicker technology increasingly cost-effective and therefore

accessible to students and teachers alike. Clickers are similar to standard household remote controls, except that modern radio frequency (RF) technology does not require that the device be pointed at a receptor. After students respond to a question posed by the instructor, group-level response data are immediately displayed. The systems generally involve 4 basic elements: 1) computer with projection, 2) clickers, 3) hardware connected to the computer for receiving signals from clickers, and 4) software for processing data from the clickers.

There is a growing body of literature on clickers, though the data are scattered across many disciplines and tends to be very fragmented (see Banks, 2006). Though a number of scholars have written about this technology, and rigorous empirical studies exist, the scholarship of pedagogy with regards to clicker technology is still emerging. Much of the recent research on clickers is from the sciences (Judson & Saweda, 2006), so a truly interdisciplinary understanding of the pedagogical value of this technology is still at an early stage. There has not yet been systematic research that compares different pedagogical uses of clickers, and such research is critical to the future of effective use of clickers as their popularity continues to grow (Penuel, Abramson, & Roschelle, 2006).

A number of authors have hailed clickers as a mechanism for enhancing active learning. For example, Hinde and Hunt (2006) touted this technology as an active learning tool. Based on survey responses from first-year business students enrolled in an introductory economics course, they concluded that clickers had improved student concentration during class meetings. McCabe (2006) identified clickers as a useful way to engage students through question-asking in large classes. Advocates have argued that clickers are especially effective with shy students because student responses can be collected, aggregated, and shared anonymously (see, e.g., Banks, 2006), though some data suggests the anonymity aspect to clickers is of little value to students (Hinde & Hunt, 2006).

In a large lecture setting, clickers can be used to engage students and involve them in the class session beyond the passive role traditional to large lectures (Cutts, 2006; Webking & Valenzuela, 2006). Cutts (2006) used clickers in every section of a large computer programming lecture class. Students seemed to respond positively to the clickers, and Cutts emphasized the importance of clickers for breaking up the lecture sessions and stimulating student engagement in what is otherwise generally considered to be a passive 'download and process at a later time' student experience in large lecture classes. Regardless of whether the anonymous aspect of clicker systems is important to many students, the systems have clear advantages over more traditional 'show of hands' or colored flash card student response systems because they can quickly and accurately aggregate and quantify students responses (Hinde & Hunt, 2006).

The available data suggests that this technology is a promising avenue for future developments in pedagogy (see, e.g., d'Inverno, Davis, & White, 2003; Ewing, 2006; Forsyth & Archer, 1997), but findings are mixed as to whether effective use of clickers can improve student learning (MacArthur & Jones, 2008). For example, Ewing (2006) found no effect of clickers on final course grades, while Kennedy & Cutts (2005) found positive learning outcomes to be associated with use of clickers in a first-year computer science course.

In a recent study, Poirier and Feldman (2007) found students who used clickers in a large introductory psychology course had better exam scores and more positive attitudes toward clickers. However, in that study the use of clickers was embedded in a small group discussion activity. The control group had no such discussion component. In other words, the design confounded use of clickers with an interactive discussion element. While it seems very likely that the effective use of clickers was at least partially the cause of the higher performance in their treatment group, it was not possible for the researchers to tease out the differential effects of the clicker feedback system from the interactive discussion activity. Indeed, another recent study by Stowell and Nelson (2007) did not find better performance on learning outcomes for clicker users as compared to flash card and hand raising audience participation methods.

The current study was designed to shed some light on the effective use of clickers in large introductory university classes. Recent research suggests that using clickers can be advantageous in large classes across a variety of types of learners (MacGeorge et al., 2008). A primary objective of the current study was to examine the degree to which students believed that using clickers helped them to understand course content, and to which they believed that clickers helped them to prepare for examinations. In addition to gathering some structured feedback from students about the experience of having used clickers in an introductory psychology class, the present study was designed to evaluate whether minor changes made to instructor usage of this technology in the classroom from one year to the next, as well as increasing levels of instructor comfort and ease of use, led to improved student perceptions of the technology. Furthermore, the present study gathered clicker feedback data from students in several different professors' courses to examine student perceptions of the effectiveness of clicker technology usage across disciplines.

## Method

### Participants

In total, 516 students participated: 314 in 2006 and 202 in 2007. Overall, 62.2% of participants were from introductory psychology courses. Of the survey participants from 2006, 46.8% (n = 147) were introductory psychology students, and in 2007, 86.1% (n = 174) were psychology students. The non-psychology students were enrolled in five
different courses in different disciplines including accounting, economics, biology, physics, and philosophy.

### Introductory Psychology Teaching Method

There were several teaching objectives to which the clicker use was tailored. First, the technology was intended to increase student engagement by stimulating their awareness periodically throughout the lectures. Rather than allow students to lapse into a typical passivity during lecture sessions, the clickers require periodic engagement with the material. In a general sense, periodically requiring students to respond to clicker questions was expected to prevent their attention from drifting too far afield from the topic at hand. Requiring clicker participation for a small portion of the course grade (10% in 2006, which was reduced to 5% in 2007) was designed to bolster attendance. In addition, employment of the clickers was intended to provide feedback to the students about their understanding of course material. Similarly,

clickers use was to provide the instructor with feedback on students' understanding. The feedback was expected to be of use to the instructor in terms of overall planning and preparations for lecture sessions, as well as for making on-the-fly clarifications and elaborations when the clicker data indicated significant confusion about a topic. Clickers were also intended to help students develop familiarity and comfort with the style of multiple choice questions that would later appear on their examinations. Students were expected to be less anxious on exam days, and thus exhibit better performance, by having had practice with multiple choice questions in class that were to be very similar to the types of questions they would see on exams. Thus, a primary goal of the present study was to examine the degree to which students perceived clickers to be a pedagogical aid, and to evaluate the degree to which they believed that using the clickers assisted them in preparing for examinations.

The pedagogy involved a straightforward use of multiple-choice questions periodically during lectures. Mostly, these questions were review of material that had just been covered in lecture, which would be clarified depending on student performance. Given the relatively superficial nature of the content for introductory psychology survey courses, there was no peer discussion of the clicker questions. Occasionally, clicker questions were used to preview lecture content from the assigned reading. Every single lecture session included clicker questions.

The clicker pedagogy gradually evolved based on usage of the clickers, instructor comfort with the technology, and based on student feedback and the flow of class meetings. By the end of the first term (Fall, 2006), there was a consistent pattern of clicker usage: 2-3 clicker questions spaced pretty evenly throughout each 75-minute lecture. Clicker questions appeared about every five or seven lecture slides.

**Survey Data Collection**

During the last two weeks of classes during winter 2006 and 2007 semesters, survey data was collected from students who were using clickers in a university course. After receiving approval for this survey from the Saint Mary's University Research Ethics Board, student participation was solicited from all instructors at the institution who were using clickers in their classes (approximately 20 instructors). A total of five professors from other departments, who were using the clickers in their courses, agreed to cooperate in the study and asked their students to participate. The student participants were from a variety of courses in terms of disciplines and class size. The survey instrument included six quantitative items (see Table 1). In 2006, the instrument included one general open-ended question about the clickers, and in 2007 there were two additional open-ended questions designed to identify aspects of clicker use perceived to be 'most helpful' and 'least helpful' to students.

## Results

**Quantitative Data Analyses**

Clear trends were evident among responses to the six quantitative items on the survey,
see Table 1. Independent variables included the sample year (2007 vs. 2006) and student status (introductory psychology vs. all other courses). For all 6 quantitative variables, student evaluations were more favorable in 2007 than in 2006. In addition, all six item responses were more favorable among introductory psychology students

compared to other participants. All quantitative items were highly inter-related; see Table 2 for bivariate correlations among items, Cronbach's Alpha, and split-half reliability analysis.

Given the high level of inter-item agreement, a composite variable was created by summing responses to the six quantitative questions about clickers. Sample year and student status were regressed onto this new composite variable; they accounted for 12% of the variance: $R (2, 511) = .34$, $p < .001$, $F = 33.19$, $p < .001$, with β for sample year = .15 ($p = .001$) and β for student status = .25, $p < .001$.

**Table 1**. Quantitative items by sample year (2007 versus 2006) and student status (Intro to Psych compared to all Others).

| Survey Item (all items measured on 7-point scales) | '06 M(SD)<br>'07 M(SD) | t, $r_{pb}$ | Oth. M(SD) Psy. M(SD) | t, $r_{pb}$ |
|---|---|---|---|---|
| How positive is your overall evaluation of the "clicker" technology?<br>(Grand mean = 5.28, SD = 1.56) | 5.0 (1.6)<br>5.7 (1.3) | 5.5, .24 | 4.8 (1.6)<br>5.6 (1.5) | 5.6, .24 |
| To what extent has the use of the "clicker" technology helped you to stay engaged during class time?<br>(Grand mean = 5.11, SD = 1.65) | 4.8 (1.7)<br>5.6 (1.4) | 5.2, .23 | 4.6 (1.7)<br>5.5 (1.5) | 6.3, .27 |
| To what extent has the "clicker" technology provided useful feedback to you about your understanding of course content?<br>(Grand mean = 5.19, SD = 1.65) | 4.9 (1.7)<br>5.6 (1.5) | 4.4, .19 | 4.6 (1.7)<br>5.6 (1.5) | 6.9, .29 |
| Do you think that the benefits of the "clicker" technology are worth the financial cost of purchasing and registering it?<br>(Grand mean = 4.01, SD = 1.97) | 3.7 (2.0)<br>4.6 (1.8) | 5.2, .22 | 3.3 (2.0)<br>4.4 (1.9) | 6.3, .27 |
| If you had an opportunity to take another course for which the "clicker" technology was part of the course, to what extent would your interest in the course be increased by the fact that the course would involve the use of "clicker" technology?<br>(Grand mean = 3.88, SD = 1.97) | 3.6 (2.0)<br>4.4 (1.7) | 4.6, .20 | 3.2 (2.0)<br>4.3 (1.7) | 6.8, .29 |
| How much do you agree with the statement that more instructors at SMU should make use of "clicker" technology in their courses?<br>(Grand mean = 4.38, SD = 1.91) | 4.0 (1.9)<br>4.9 (1.8) | 5.2, .23 | 3.7 (2.0)<br>4.8 (1.8) | 6.3, .27 |

Note: All sample year and student status comparisons (and corresponding point-biserial correlations) significant at $p < .001$.

**Table 2**. Bivariate correlations among quantitative items from the clicker survey.

| | **Overall** | **Engaged** | **Feedback** | **WorthCost** | **OtherCourse** | **UseMore** |
|---|---|---|---|---|---|---|
| **Overall** | 1.00 | .76 | .73 | .72 | .68 | .77 |
| **Engaged** | | 1.00 | .74 | .70 | .64 | .70 |
| **Feedback** | | | 1.00 | .66 | .63 | .69 |
| **WorthCost** | | | | 1.00 | .71 | .76 |
| **OtherCourse** | | | | | 1.00 | .80 |
| **UseMore** | | | | | | 1.00 |

Note. Item names are abbreviated, see Table 1 for full text of items. All quantitative items were highly related: all correlations are significant at $p < .01$; Cronbach's Alpha for the six items was .93. Guttman split-half reliability analysis yielded scores above .89 for each half of the sample.

## Qualitative Data Analyses

The open-ended responses were subjected to a content analysis. In total, there were three open-ended survey questions: a 'general comments' question, as well as two questions pertaining to 'most helpful' and 'least helpful' uses of the clickers. These latter two items were present only in the 2007 version of the survey. Two independent raters completed a content analysis of these qualitative items. Raters coded each response for presence or absence of a series of content themes. These decisions were not mutually exclusive: a single comment could contain multiple themes. Cohen's Kappa was used to evaluate intercoder agreement; all Kappas for themes reported here were at the level of at least .73. For the purpose of summarizing these data, when there was disagreement between coders, responses were considered to be in the affirmative. See Table 3 for the results of the content analysis.

Among the most common general comments were complaints about cost and technical difficulties, but also positive comments about clickers as a learning tool and as an attendance incentive (see column 2, Table 3). Moving to the more specific items included in the 2007 survey, almost half of the participants (46%) commented that the clickers had helped in some way with understanding course material, and almost 20% said that the clickers had helped them to prepare for examinations. Fifteen percent of participants commented favorably on the instant feedback aspect of the clickers, almost 12% said that it helped with attention / engagement during class time, and 10% commented that the clicker was a motivational tool (e.g., to study harder, to be more diligent preparing for class). In terms of 'least helpful' comments, themes were basically centered on financial cost (11.9%), technical difficulties (11.4%), and attendance difficulties including forgetting the clicker (10.9%).

**Table 3**. Content analyses of participant responses to open-ended questions about "most helpful" and "least helpful" clicker uses.

| "Most Helpful" uses of clickers (N=202) | | General comments about clickers (N=516) | |
|---|---|---|---|
| **Theme** | **Valid % (n)** | **Theme** | **Valid % (n)** |
| Helped with understanding course material | 46.0 (93) | Cost-related complaints | 17.8 (92) |
| Helped with preparation for examinations | 18.8 (38) | Learning tool | 8.1 (42) |
| Instant feedback | 15.3 (31) | Technical difficulties | 5.4 (28) |
| Helped with attention/engagement | 11.9 (24) | Helped/enhanced attendance | 4.7 (24) |
| Motivational tool (e.g., to study harder) | 9.9 (20) | Helped with attention/engagement/active learning | 4.7 (24) |
| | | Attendance-related complaints | 4.7 (24) |
| "Least Helpful" uses of clickers (N=202) | | | |
| **Theme** | **Valid % (n)** | Not used enough on campus | 3.9 (20) |
| Financial cost too high | 11.9 (24) | Not used enough in class | 3.3 (17) |
| Technical difficulties | 11.4 (23) | Allowed for anonymous participation | 1.7 (9) |
| Attendance difficulties (including forgetting the clicker) | 10.9 (22) | Graded clicker activities too stressful | 1.6 (8) |
| Not used enough in class | 4.0 (8) | Cheating (e.g., people bring others' clickers) | 0.8 (4) |

## Discussion

The present study is an incremental step at developing a broad-based, cross-disciplinary understanding of most and least effective uses of clickers in higher education. As noted in the introduction, the emerging literature on this technology in higher education is heavily weighted toward the sciences (Judson & Saweda, 2006) and is fragmented across a diversity of disciplines (Banks, 2006). According to Penuel and colleagues (2006), the future of clickers in higher education will depend in large part upon the state of systematic, cross-disciplinary research on their pedagogical uses and effectiveness.

Based on overall mean student responses to the seven-point scales on the first three quantitative items on the survey, it does seem clear that students liked the clickers (M = 5.3), that they believed the use of clickers helped them to stay engaged in class (M = 5.1), and that the clickers provided helpful feedback about understanding of course content (M = 5.2). Among the key themes identified in the content analysis of students' responses to the open-ended questions were numerous comments about clickers as a useful learning device, including clickers as a motivational tool, as a way of enhancing attention/engagement during class, and satisfaction with the instant feedback aspect of the clickers.

One thing that is clear from the present study is that students perceive that using clickers helped them to understand course content. This is clear from the quantitative data, which also showed a year-over-year improvement on that item in 2007 compared to 2006. This point is further reinforced by the fact that in 2007, about half

of the student participants volunteered in their open-ended comments that the use of clickers had helped them with understanding course material, and almost one fifth specifically noted that using clickers had helped them to prepare for examinations. These qualitative data are especially noteworthy given that students were prompted simply to comment on the 'most helpful' aspects of the ways in which their instructor had used the clickers. Taken together, the quantitative and qualitative data from the current study outline a clear path for future clicker-related pedagogy and research on effective clicker use: employing clicker technology as a mechanism for facilitating student performance and comfort with learning evaluation measures. This seems an especially important benefit of this technology when it comes to large lecture settings in which evaluation activities can be very stressful for students.

The present data show that student impressions of the technology are closely connected to the learning context in which the clickers were used. Compared to students in other courses, students in introductory psychology courses in which the technology was used mainly for periodic multiple choice feedback questions during lecture sessions, had more favorable evaluations of the clickers on all survey items (including cost).

These data suggest that the periodic-review-multiple-choice-question teaching method with the clickers was effective in terms of student satisfaction with the technology. Taking into account previous research that suggests that clickers may lead to improved learning outcomes in introductory psychology (Poirier & Feldman, 2007), it seems clear that a straightforward multiple-choice question clicker methodology can be an effective usage of this technology for large introductory courses.

What is not yet clear, however, is whether the clickers themselves can be a reliable vehicle for improved student learning. The present study is limited to student perceptions of clicker usage. Prior research on the relationship between clicker use and student performance has been mixed. Poirier and Feldman (2007) found that grades were higher for students using clickers in class, but the clicker users also engaged in brief small group discussions as part of the clicker activity (the control group had no such activity). Other recent studies have found no difference in grades between clicker use with discussion as compared to discussion with hand raising, however (Lasry & Findlay, 2007; Stowell & Nelson, 2007), supporting the notion that this technology may not be necessary in some circumstances. In a recent review of 56 studies related to clickers in college-level science education, MacArthur and Jones (2008) found mixed support for enhanced student learning associated with clicker use. Teachers must be careful about gimmicky use of technology without specifically tailoring use of the devices to clear learning objectives.

Another facet of these data is that the quantitative items were all very highly inter-related. This clearly illustrates the global nature of student perceptions of this technology and suggests that, if instructors can bolster students' perceptions of one aspect of the technology, then the positive evaluation is likely to spill over into other evaluative judgment categories. For example, if a philosophy professor's use of the technology convinces her students that the devices help them to stay engaged in class, it will follow that their perceptions of the financial cost and campus-wide use of clickers will also be favorable. MacGeorge and colleagues (2008) noted that perceptions of clickers are highly related to overall course evaluations and referred to this type of an inter-related global evaluation of clicker technology as a 'halo' effect.

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One limitation to the current study, a drawback common to most SoTL research, is the absence of experimental control. Instructor enthusiasm about the clickers may have contributed to more positive impressions among the introductory psychology students as compared to the non-psychology students. Still, it seems clear from the quantitative data that student experiences with clicker technology are closely associated with the specific ways in which they are used in class. It is unlikely that instructor enthusiasm alone could account for the differences across disciplines. Instead, it seems more likely that differences in the ways in which the various instructors were using the clickers account for differences in students' evaluations of the clickers. Of course, the present study does little to elaborate what those pedagogical differences were. Future research should extend the current findings from a systematic, multi-disciplinary approach that differentiates among the wide variety of pedagogical techniques that can be used with clickers (Penuel et al., 2006).

Many of the negative comments are likely to stem from the newness of this technology. It is clear that some of the participants in the survey experienced frustration due to technical difficulties with the clickers. These data demonstrate that student experiences will improve as faculty become more expert with the technology. The clear differences between 2006 and 2007 quantitative responses strongly suggest that as instructors become more experienced with clickers, this will result in improved student experiences with them.

Effective use of clickers has the potential to increase student engagement in traditional large introductory psychology courses, and may serve to facilitate student learning. The current study clearly illustrates students' positive views about clickers, particularly with regard to the perceived usefulness of clickers in terms of understanding course content and preparing for examinations. Future research can elaborate the most and least effective approaches for the use of clicker technology. Systematic, cross-disciplinary research that compares different pedagogical techniques in different settings is an objective that researchers should strive for in order to facilitate future usage of this powerful technological innovation that is gaining in popularity.

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