Clicking Their Way to Success: Using Student Response Systems as a Tool for Feedback

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Purpose of the Study: Feedback is identified in many learning theories as a key component to successful learning. This study investigates the effectiveness of providing immediate feedback with student response systems (or "clickers") on multiple measures of student performance, including exam scores, self-reported understanding and attitudes.

Design and Sample: Prior studies generally show that clickers improve student performance. However, most of these studies cannot identify what causes these improvements. Further, design limitations of many studies, such as lack of control conditions or a between-subjects design, have reduced researchers' abilities to infer causal relationships between clicker utilization and student learning. The aim of the current research is to help fill this gap in the literature. The first study uses a within-subjects design in which two sections of an undergraduate marketing class used clickers at different times over the course of the semester. The second study replicates the results of the first study using a between-subjects design.

Results: When clickers were used to facilitate feedback, students reported a better understanding of the materials, read more chapters before class, were more likely to recommend the course to others, and had higher exam scores than when clickers were used just for attendance.

Value to Marketing Educators: These results demonstrate how the use of clickers can improve marketing education. The results suggest that eliciting performance from students (in this case, responding to questions with clickers) and providing feedback improves students' learning, performance, and attitudes. This will help marketing educators know when and how to use clickers.

Keywords: Student Response System, Clicker, Feedback

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Higher education has recently received considerable criticism as researchers have suggested that undergraduates learn little while they are in school (Arum and Roksa 2011; Pascarella, Blaich, Martin, and Hanson 2011). Business education has received some of the harshest criticism as studies have found business undergraduates spend less time studying and have smaller gains on standardized tests than other undergraduates (Glenn 2011). These problems are likely partially attributable to business students' lack of engagement and accountability (Arum and Roksa 2011; Pascarella et al. 2011), problems that are exacerbated by large class sizes at many colleges and universities. An increasingly adopted classroom technology to address these issues is student response systems (or "clickers"). Some studies suggest that clickers can improve classroom atmosphere, engagement, accountability, and exam scores, while other studies are more equivocal (Caldwell 2007). However, design limitations of many studies, such as lack of control conditions or reliance on self-reports, have reduced researchers' abilities to infer causal relationships between clicker utilization and student learning outcomes (Caldwell 2007; Roschelle, Panuel, and Abrahamson 2004; Simpson and Oliver 2007) and to determine what factors lead to these improvements (Camey, Gray, and Wert-Gray 2008). The aim of the current research is to help fill this gap in the literature by testing one way clickers can improve learning – providing students with immediate feedback about their performance.

BACKGROUND ON STUDENT LEARNING

There are two main families of learning theories, namely S-R (stimulus-response) conditioning theories related to behaviorism and cognitive theories. Behaviorism or S-R conditioning theories suggest that learning is a change in observable behavior. Stimuli act upon the learners causing them to respond or increase the probability that they will respond in a certain way. The responses or effects are the reactions of the learning to the stimuli (Bigge 1982).

Cognitive learning theories suggest learning is a process of gaining or changing insights, expectations, or thought patterns. Gagné proposed nine elements of

instruction based on the information-processing model (Gagné 1985: 52-71; Atkinson and Shiffrin 1968; Matthews, Janicki, He and Patterson 2012). These elements follow the sequential order: (1) gaining attention, (2) informing learners of the objective, (3) stimulating recall of prior learning, (4) presenting the stimulus, (5) providing learning guidance, (6) eliciting performance, (7) providing feedback, (8) assessing performance, and (9) enhancing retention and transfer (Matthews et al. 2012: 72).

A key component of most learning theories – including behavioral and cognitive learning theories – is a feedback loop or reinforcement. Responses are required from learners after they have been given sufficient material to comprehend an objective (Gagné 1985; Matthews et al. 2012). Responding enables students to reinforce their understanding. Feedback is provided by the learners' observations of the effects of their performance (Gagné 1985). Martin, Klein, and Sullivan (2007) found that eliciting performance and providing adequate feedback are the events correlated the highest with student success. Students who receive feedback before they have formulated their own answer do not learn as much as students that formulate their own answer before they are provided with feedback (Kulhavy 1977). This suggests that having students respond to a question is more effective than merely asking a question and not eliciting a response. Prior research has shown that learning is improved when students received corrective feedback on incorrect answers (Guthrie 1971) and that learning is improved with immediate feedback versus delayed feedback (Kulik and Kulik 1988).

Clickers are handheld devices that can improve instructors' abilities to provide immediate feedback by recording and assessing students' responses during lectures. Although other less expensive techniques (e.g., raising hands) can provide some of the same benefits, clickers and related technologies can provide anonymity, individual-level storage of responses for assessment, and real-time tallying and presentation of responses, all of which can improve the effectiveness of feedback. Clickers also minimize the effects of social proof and seeing other students' responses (Cialdini 2008). Technological limitations marked early clickers, making them difficult to use and unreliable, but improved radio frequency technology and software has made them more reliable and easier to implement. In addition, clicker prices have decreased over the years, so they are now relatively inexpensive (approximately $30) and can be purchased and sold back to many campus bookstores and online retailers. Combined, this suggests clickers may be cost-effective tools to improve feedback to students.

HYPOTHESES

Students have a difficult time assessing their level of comprehension of course materials when they do not receive regular feedback (Sitzmann, Ely, Brown and Bauer 2010). Clickers can enhance students' learning by making lectures more engaging, providing immediate feedback to students about their own understanding of material, and assisting students to reinforce key concepts (Caron and Gely 2004; Edmonds 2005; Mula and Kavanagh 2009; Tietz 2005). Clickers effectively facilitate feedback when they are used to provide students with real-time, objective feedback about their current comprehension of course materials. Thus,

> **H_1**: Students' abilities to assess their own knowledge of the materials will be higher when clickers are used to provide regular feedback, in the form of individually graded questions, than when they are not used to provide feedback.

Real-time feedback may also increase out-of-class study time. Control theory and self-regulated learning (Carver and Scheier 1990; Butler and Winne 1995), Sitzmann et al. (2010) suggest students engage in self-regulatory activities over the length of a course, applying effort in an attempt to learn the material. Periodically, they assess their progress and determine if there is a discrepancy between desired and actual knowledge (Carver and Scheier 1990). When learners detect a discrepancy, it influences their behaviors (Carver and Scheier 1990; 2000; Sitzmann et al. 2010; Zimmerman 1990). Instruction techniques that provide extensive feedback provide students with more information that they can use to accurately assess their learning (Butler and Winne 1995; Kanfer and Kanfer 1991).

Clickers can improve distribution of studying across the semester by incentivizing students to read before attending class. This can happen if, for instance, points are assigned based on answers to daily quizzes (Mayer et al. 2009). Clickers were used this way in one of the conditions in Study 1. Students answered questions every day on readings that were assigned to be read prior to class. Full credit was given for correct responses and no credit was given for incorrect responses. This way of using clickers provided incentive to read assigned materials prior to class as students' final grades were partially based on their performance on these "mini-quizzes." Further, clickers give students a means to better self-assess their knowledge and adjust their study habits accordingly by providing immediate feedback when they answer questions during lectures. Thus,

> **H_2**: The number of students who read chapters prior to attending class will be higher when clickers are used to provide feedback than when they are not used to provide feedback.

Several studies suggest that clickers improve exam scores, grades, and learning outcomes (Camey, Gray and Wert-Gray 2008; Preszler, Dawe, Shuster and Shuster 2007; Sprague and Dahl 2010). However, other studies have found that clickers either do not improve or provide minimal improvements to exam scores and grades (Carnaghan and Webb 2007; Lasry 2008; Morgan 2008; Morling, McAuliffe, Cohen and DiLorenzo 2008; Nelson and Hauck 2008; Stowell and Nelson 2007). The focus on clickers, instead of how they are used, may cause these seemingly

inconsistent findings. Clickers can be used in many ways (Lincoln 2009). It is likely that using clickers in a static way (e.g., taking attendance) will have very different benefits than using clickers in a more interactive manner (e.g., daily mini-quizzes).

Clickers can be particularly effective at improving learning outcomes by providing real-time feedback as the instructor immediately knows what percentage of the class correctly understood a concept based on the questions asked. The instructor can then provide feedback to the class based on their answers to clicker questions. Clickers force students to pick an answer themselves instead of potentially relying on others, as in the case of having students raise their hands. Clickers also help an instructor know when extensive feedback is warranted. Instruction techniques that provide extensive feedback provide students with more information that they can use to accurately assess their learning (Butler and Winne 1995; Kanfer and Kanfer 1991). Students are more likely to change their study habits when they receive this kind of early and frequent feedback that demonstrates their current study habits are not adequate (Love, Love, and Northcraft 2010). Without this feedback, students are more likely to engage in such practices as cramming for exams, which McIntyre and Munson (2008) found negatively affects knowledge retention versus distributing study time across a longer timeframe. Further, when students feel more engaged in the learning situation, they are more likely to work hard to make sense of the course materials and therefore more likely to perform better on assessments measuring learning (Mayer et al. 2009). Thus,

H_3: Exam scores will be higher when clickers are used to provide feedback than when they are not used to provide feedback.

Providing real-time feedback and evaluation with clickers could have a positive effect on attendance. This can happen through indirect means if, as prior research has shown (Beekes 2006; Elliot 2003), clickers increase engagement and evaluations of the class. Further, clickers can be used to assign points based on attendance or on daily quizzes. If points are assigned to class attendance or participation, clickers provide a direct incentive for students to attend class, which should improve attendance and exam scores. However, it is also possible for clickers to have a negative effect on attendance. This can happen if students do not like using clickers or if points create a disincentive for class attendance. There was a potential for both positive and negative effects in the study, making it impossible to develop a hypothesis for attendance in the experiments. This difficulty is discussed more in the results section.

To summarize, the authors hypothesize that clickers' ability to provide timely, salient feedback will have a positive effect on multiple elements of learning including ability to self-assess knowledge, engagement, and exam scores. Prior studies on this topic have suffered from limitations such as reliance on self-reports and inadequate experimental designs (Roschelle, et al. 2004; Simpson and Oliver 2007; Young, Klemz, and Murphy 2003). These limitations can be addressed by manipulating the use of clickers within subjects and by collecting objective measures such as attendance and exam scores. Further, unlike several studies cited above, student engagement measures and exam scores are collected *within the same study* in this article. This aids in examining what factors (e.g., attendance, ability to self-assess, reading before class) contribute to improved exam scores.

Study 1 Description

The clickers used in the study were Turning Technologies ResponseCard RF devices. These response devices are small, roughly the size of a credit card (3.3" × 2.1" × 0.3" and 1 ounce), and work by sending responses with radio frequencies. This brand of clicker was chosen by the university's technology center as the standard clicker to be used in all classes.

Two sections of an undergraduate Consumer Behavior course at a large, Midwestern university were involved in the study. Both sections in the study were taught by the same instructor. Each section had 42 students or less, which enabled the instructor to count the number of students in attendance and to verify that this number matched the number of clicker responses. All students in the study were given clickers and were required to bring them to class. Twenty percent of each student's final grade was based on responses to clicker questions.

At the beginning and end of each class, a slide was shown with all the students' names in that section. A box around each student's name changed from blue to purple after students responded using their clickers. This process allowed the instructor to take attendance and gave the students a chance to ensure their clickers were working before class started.

A within-subject design was used to test the effectiveness of clickers to provide feedback. Students in each section actively used clickers (Feedback Condition) for part of the semester and used them passively the other part of the semester (Attendance Condition). During Feedback portions of the semester, two to four multiple-choice questions with one correct answer were asked during every class (see Figure 1a). Questions were based on assigned readings to be completed before class, and students were instructed to answer without using their books or notes or consulting other people. Students received credit only for correct responses. The instructor waited until the majority of students responded before giving a three-second count for final responses. The computer automatically tallied the percentage of the class voting for any particular answer and displayed this information after all responses were collected. During Attendance parts of the semester, students saw the same information presented in the form of a definition (see Figure 1b). In this case, their clicker grades were based on attendance – students received full credit for participation on any day they used their clicker to check in and out of class. The slides in each section were presented for about the same amount of time

using the same size font. All other (non-clicker) slides were identical between conditions.

Figure 1a: Typical Clicker Question

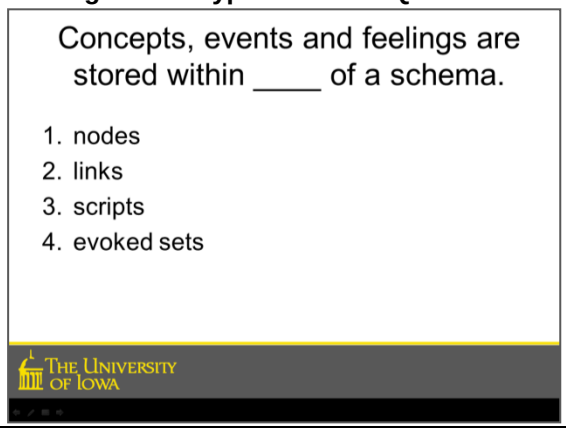
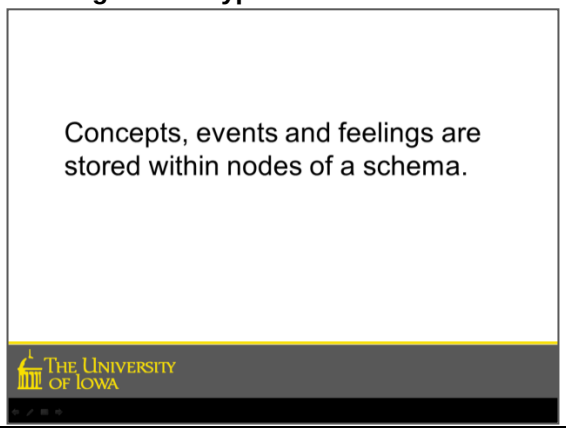


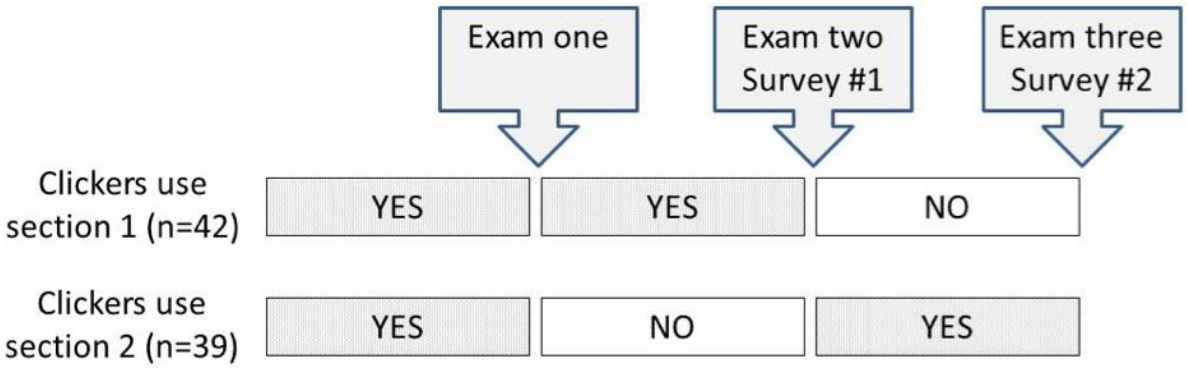
Figure 1b: Typical Definition Slide



MEASUREMENTS

The impact of using clickers to provide feedback was tested using several measures, including: (1) students' assessments of their own performance and knowledge, (2) objective assessments of performance including attendance and exam scores, and (3) students' self-reported attitudes toward clickers, the instructor, and the class. Although not directly related to the hypotheses, students' attitudes toward clickers were examined since this might affect faculty decisions to implement these devices. The course had three non-cumulative exams that were roughly the same length. The first section (n = 42) actively used clickers before exams 1 and 2, and the second section (n = 39) actively used clickers before exams 1 and 3. This allows comparisons between exam scores when students were receiving feedback while using clickers to exam scores when students used clickers only for attendance purposes. All other aspects of the lectures were identical between conditions. Anonymous surveys were administered after the second and third exams to determine whether clicker utilization affected the self-report measurements. The surveys were collected by one of the students, sealed in an envelope, and delivered to the department secretary. Survey responses were not reviewed until the semester was over and grades were submitted. Timing of the assessments and the manipulation of clicker usage is given in Figure 2.

Figure 2: Clicker Usage for Feedback Purposes



RESULTS

Self-reported measures were collected using anonymous surveys after exams 2 and 3. Students answered the questions on six-point Likert scales (1 = "strongly agree," 6 = "strongly disagree") except for the question about chapters read before class which was answered on a nine-point scale (1 = "0 of the 8" chapters, 9 = "8 of the 8"). The following analyses of variance (ANOVAs) had clicker use and section as factors. Which section the students were in was not significant in any of the analyses, so it is not discussed further. Students' responses to questions about their comprehension (i.e., "*I have a good idea how well I understand the course material*") were analyzed. As predicted, students reported a better ability to self-assess their comprehension of the course materials (2.20 vs. 2.48; $F(1, 143) = 3.976$, $p < .05$) and reported higher overall comprehension when they had actively used, relative to when they did not actively use,

clickers (2.28 vs. 2.55; $F(1, 143) = 3.097$, one-tailed $p < .05$). Consistent with hypothesis 1, feedback provided by clickers helped students assess their own knowledge of materials.

The number of chapters read was converted to a percentage of chapters read to make it easier to interpret. Students reported that they read chapters before class more often when they were in the Feedback versus Attendance condition (39% vs. 29%; $F(1, 143) = 4.207$, $p < .05$). This supports hypothesis 2, clickers increased the number of students who read chapters prior to attending class. This is consistent with the theory that students were more likely to read before class when clickers were used for feedback because they were better able to assess their own knowledge and wanted to improve their performance in class.

Table 1: Survey Responses after Exams 2 and 3

Question	Feedback Condition Mean (SD)	Attendance Condition Mean (SD)
How many times did you read all or part of a chapter prior to the class that discussed that material	39% (0.33)	29% (0.29)
I have a good understanding of the material	2.28 (0.80)	2.55 (1.00)
I have a good idea how well I understand the course	2.20 (0.79)	2.48 (0.94)
I would recommend a course taught by this instructor to other students	1.55 (1.12)	1.84 (1.03)

Number of students responding to each survey: section 1: exam 2 (n = 37), exam 3 (n = 38), section 2: exam 2 (n = 35), exam 3 (n = 34).

Attendance was examined to determine if it was affected by the manipulation. No significant difference in attendance between conditions ($p > .4$) was found. However, an important qualifier emerges with this finding. In this study, students received course credit based on the number of correct responses in the Feedback condition. Therefore, most students received partial credit (e.g., three of five correct responses = 60%) during a typical class. In the Attendance condition, students received 100% credit for attending class and no credit for not attending class. This created more incentive to attend class when clickers were used solely for attendance purposes than when they were used for feedback purposes. Other incentive structures could very likely lead to increased attendance when using clickers to provide feedback.

The analysis of exam scores focused on the second and third exams when clicker use was manipulated. The second exam had 70 questions while the third had 78 questions that were primarily generated from the publisher's multiple-choice test bank. Reliability was calculated with the Kuder-Richardson formulation (KR-20 = 0.80 and 0.79 respectively). A repeated measures ANOVA was run, with exam scores (Feedback/Attendance) as repeated measures and course section as a between-subjects factor. This process helped to control for individual differences and differences between sections. Students' exam scores were higher in the Feedback condition ($M_{Feedback}$ = 78.3%) than the Attendance condition ($M_{Attendance}$ = 75.4%; $F(1, 79) = 6.76$, $p < .05$) and course section was not significant ($p = .598$). To make sure this result was not driven by differences between the exams, the same analysis on z-standardized (within exams) scores was run. Clicker use remained significant in this analysis ($F(1, 79) = 6.42$, $p < .05$). Additionally, a paired t-test on the exam scores showed that clicker use significantly improved exam scores ($t(1, 80) = 2.59$, $p = .011$). These results support hypothesis 3, exam scores were higher when clickers were used to provide feedback. While this effect size is relatively small (Cohen's $d = 0.290$; Cohen 1977), it does represent a roughly one-third letter grade improvement. These results provide additional evidence that real-time feedback provided by clickers enhanced learning among students.

Finally, though not directly related to the hypotheses, students' attitudes toward clickers were examined since this might affect faculty decisions to implement these devices. Students answered these questions on a six-point Likert scale (1 = "strongly agree," 6 = "strongly disagree") at the end of the semester after exam 3. Detailed results appear in Table 2. Of the students, 77.8% agreed that clickers made the class more interesting, and 77.8% also agreed that clickers improved their understanding of the course materials. In addition, 67.6% agreed that clickers were a useful way to evaluate whether students understood the course material, and 68.1% said they enjoyed using clickers in class. But support for clicker use was not absolute: 29.2% believed clickers were inconvenient and a hassle. Additionally, students were more likely to recommend the instructor when they were in the Feedback condition than when they were in the Attendance condition (1.55 vs. 1.84; $F(1, 143) = 3.933$, $p < .05$). Students had a better attitude about class when clickers were used to provide feedback than when they were used for attendance.

Table 2: Attitudes toward Clickers End of Semester

Question	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Disagree	Strongly Disagree
Clickers make the class more interesting.	26.4%	26.4%	25.0%	5.6%	5.6%	11.1%
Clickers have improved my understanding of the material.	18.1%	27.8%	31.9%	5.6%	5.6%	11.1%
Clickers are a useful way to evaluate whether students understand course materials.	18.3%	23.9%	25.4%	16.9%	7.0%	8.5%
If I had my choice, the class would not have clickers.	16.7%	11.1%	15.3%	31.9%	8.3%	16.7%
I enjoyed using clickers in class.	20.8%	18.1%	29.2%	18.1%	4.2%	9.7%
Bringing clickers to class is inconvenient and a hassle.	4.2%	6.9%	18.1%	13.9%	29.2%	27.8%

Combined, these results suggest that student engagement, interest, perceived understanding of course materials, and ability to self-assess increased when clickers were used to provide feedback.

Study 2 Description

Study 1 addressed limitations from prior studies by experimentally manipulating use of clickers within subjects. This has many advantages such as increased statistical strength and the ability to manipulate the variable of interest (i.e., using clickers for feedback) while holding other factors constant (e.g., instructor differences, student differences). However, the experimental manipulation has some limitations. For example, students may have had enhanced focus when clickers were used for feedback. To address this concern, clickers were used to give feedback for an entire semester the following year and clicker effectiveness from the Attendance conditions described in Study 1 were compared to clicker effectiveness in these sections.

Specifically, the impact of using clickers to provide feedback was tested using (1) exam scores and (2) students' self-reported attitudes toward the instructor and the class. Like Study 1, the course had three non-cumulative exams that were roughly the same length. The first section had 45 students while the second section had 35 students. All other aspects of the lectures (e.g., instructor, clicker questions, time of instruction) were similar between conditions.

RESULTS

The first analyses tested whether exam scores were higher in the subsequent year (when feedback was given all semester long) than in the Attendance condition the prior year. Like Study 1, the analysis focused on the second and third exams when clicker use was manipulated. An ANOVA was run with year, exam (2^{nd} or 3^{rd}), and their interaction as factors. Students' exam scores were higher in the year when feedback was given throughout the semester ($M_{Feedback}$ = 78.2%) than in the year when clickers were used for attendance ($M_{Attendance}$ = 75.4%; $F(1, 237) = 4.52$, p = .035) while exam and the interaction term were not significant (p = .538, p = .335, respectively). To ensure the result was not driven by differences between the exams, the same analysis was run on z-standardized (within exams) scores. Clicker use remained significant in this analysis ($F(1, 237) = 4.64$, p = .032). A t-test showed that clicker use significantly improved exam scores ($t(1, 239) = 2.10$, p = .037), supporting hypothesis 3 and providing additional evidence that real-time feedback via clickers enhanced learning among students.

Students were more likely to recommend the instructor in the subsequent year when clickers were used for feedback than in the prior year when clickers were used in the attendance condition ($M_{Feedback}$ = 1.10 vs. $M_{Attendance}$ = 1.84; $t(148) = 6.12$, $p < .001$), suggesting that they had a better attitude about class when clickers were used to provide feedback than when they were used for attendance.

LIMITATIONS

The results are consistent with the theory that test scores increased because feedback provided by clickers increased students' abilities to assess their own learning and adjust their study habits accordingly. Mediation analysis would provide a more complete picture about how the self-reported measures affected test scores. However, it is not possible since each student's test scores cannot be linked to their

anonymous, self-reported measures. Benefits from anonymity (e.g., increased honesty in answering questions, decreased privacy concerns) likely offset the drawbacks inherent to the lack of a mediation analysis, but future studies could be designed to address this limitation.

Although clickers have been available for several years, they are still relatively new to many instructors and students. While many courses in our college use clickers, the target course was the only one using clickers in our department. This means there was a potential for novelty effects, which could inflate some of the studies' measures and make clickers seem more effective than they normally would be. Alternatively, this newness could have hurt the measures since the instructor had little experience with clickers and students may have been nervous about using a new technology. In addition, the research focused on the impact of clickers on students but did not investigate the impact of clickers on the instructor. Since clickers can be used to provide timely feedback about student comprehension, it seems likely that this information could be used by instructors to adjust their teaching. Future research could address these issues by examining how past experience with clickers alters their effectiveness and by examining how instructors are impacted by clickers.

GENERAL DISCUSSION

At a time when the value proposition for college is being questioned, class sizes are increasing, and students are evermore distracted, it is increasingly important for faculty to provide timely and relevant feedback, improve student class preparedness, and improve student educational outcomes. Recent studies have shown that undergraduate students' scores on standardized measures of critical thinking and complex reasoning improve very little while they are in college (Arum and Roksa 2011; Pascarella et al. 2011). Unfortunately, business school students have some of the worst performance on these measures, scoring low in engagement and time spent studying as well as having some of the weakest gains in standardized test scores (Glenn 2011).

Numerous solutions have been proposed for these problems. For instance, Peer Instruction, a technique that encourages students to discuss concepts with other students, can improve conceptual and quantitative skills as well as student engagement (Crouch and Mazur 2001). Active learning techniques, which encourage students to interact with course content through talking, listening, writing, and reflecting, have been shown to improve both understanding and course enjoyment (Meyers and Jones 1993; Camp 2000; Benek-Rivera and Mathews 2004). Other active learning activities, like using game-show questions for exam review, can motivate students to participate in class and assume more responsibility for their learning (Meyers and Jones 1993; Benek-Rivera and Mathews 2004). However, it is difficult to use some of these techniques in a course with a large number of students.

Results from this study suggest that increasing the quantity and quality of feedback can improve student outcomes and that clickers are a promising tool for facilitating this feedback. Clickers facilitate delivering timely and salient feedback to students which helps them better understand not only material in class but also their own learning efficacy. However, business instructors have been slow to adopt clickers in the classroom (Lincoln 2009), and some instructors still question whether enough is known about the benefits to warrant their cost (Bugeja 2008).

Limitations inherent in existing studies have likely caused some of this trepidation. Most studies on clicker effectiveness have been conducted in large lectures with 100 or more students or in fields outside the social sciences (Caldwell 2007). Furthermore, the frequent reliance on self-reports and lack of control groups often makes it difficult to make strong inferences about how clickers affect learning outcomes (Roschelle et al. 2004; Simpson and Oliver 2007; Young, Klemz and Murphy 2003). Such difficulties have led business educators to call for additional research on clicker effectiveness: research that employs experiments to objectively measure learning, not just attitudes, while controlling for other factors (Eastman, Iyer, and Eastman 2011; Preis, Kellar, and Crosby 2011; Sprague and Dahl 2010) and research to identify what causes improved performance when using clickers (Camey, Gray, and Wert-Gray 2008).

Using a within-subjects design, the current studies' findings provide new information about how clickers can improve student performance while addressing some of the shortcomings found in existing research. Using clickers to provide feedback increased learning in midsized, undergraduate Consumer Behavior classes. Clickers enhanced student engagement, increased reading before class, and improved satisfaction with the instructor. Students reported they were better able to self-assess their knowledge of course materials when using clickers, a skill that can develop when students receive periodic feedback (Sitzmann et al. 2010). These factors likely contributed to the students' increased exam performances. Thus, as the findings suggest, clickers can be used effectively to improve student performance in midsized marketing courses.

While there is growing evidence of the usefulness of clickers, there are many practical issues that should be considered when considering the adoption of clickers. These issues include cost, technological problems, and pedagogy. Cost considerations include non-trivial time costs to the instructor and monetary costs to students. These costs can be reduced considerably when institutions adopt a single technological standard. A single standard also decreases time costs for faculty by facilitating the organization of training sessions and improving knowledge exchange between members while also decreasing costs to students by allowing clickers to be reused in other classes and resold to bookstores

(similar to textbook buybacks). Financial costs can be reduced further by using alternative devices like laptops, tablets, and smartphones when these devices are commonly available.

While technological problems have been reduced with the introduction of improved technology, issues still arise. These issues can reduce the benefits of using clickers and increase anxiety among students. A check-in screen proved to be an easy solution that helped reduce unforeseen technical problems. This process helped students address any technological problems before class, which minimized disruption during class. It also reduced student anxiety about whether their responses were being accurately recorded. This is especially important when clicker responses contribute to students' grades.

The addition of clickers to a course requires instructors to consider pedagogical issues. The authors found that using clickers to provide timely feedback on students' learning helped increase class preparation, enhanced self-appraisal, and improved test scores. However, these issues can be addressed by other means, such as increasing class discussion and improving peer instruction. It may even be more efficacious to receive feedback from a peer versus an instructor using clicker data. A review of alternative techniques is outside the scope of this study, but relevant discussions are available in existing research (Caldwell 2007; Garver and Roberts 2013; Lincoln 2008; Lincoln 2009). The authors encourage the use of clickers as a means to provide feedback to students and believe the benefits considerably outweigh the costs.

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