

## CLICKERS FOR ENGAGEMENT IN THE LARGE UNDERGRADUATE STATISTICS CLASSROOM: DO CLICKERS IMPROVE FINAL GRADES?

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*With the increase in the number of undergraduate students, the ability to actively engage all students in a large classroom is challenging. The use of student response systems or Clickers is a relatively new technology that allows the students in a large classroom to select individual responses to questions posed to them during class, thereby increasing classroom engagement. In this study, students in a large undergraduate statistics class were separated into two groups: those that used Clickers and those that did not use Clickers. Analysis revealed that there was no difference in the final grades between the students who used Clickers and the students who did not use them.*

### INTRODUCTION

Clickers allow for real-time polling in the classroom. With Clickers, students answer questions posed by the instructor and a real-time histogram of the anonymous student responses is shown for the class. Educators have adopted Clickers for use in large classrooms to enhance student engagement (Barnett, 2006). Clicker use in the classroom has been reported to increase classroom satisfaction by both instructors and students (Addison et al., 2009; Stowell & Nelson, 2007).

Studies with respect to the improvement of student test scores have been mixed. The use of Clickers have been found to not significantly improve student test scores (Patterson et al., 2010; Dawson et al., 2010) while in other cases, the Clickers have been found to have at least a minimal positive impact on test scores (Yourstone et al., 2008; Hall et al., 2005; Morling et al., 2008). For large classes, if Clickers increase interaction and engagement does this translate into higher test scores for students? Further empirical examination seemed merited.

### METHODS

Students must purchase the Clicker to be used in the classroom and the institution must install the software from the distributing company. To encourage engagement, the undergraduate statistical methods course had required students to buy and use Clickers during lectures in previous academic years. However the cost of the Clickers have increased since their introduction, resulting in students voicing concerns about the inability to afford the device. As a result, two different sections of the undergraduate statistics course were given the option to either buy the Clicker and receive 1 mark towards their final grade for its use (final exam worth 59% of final grade) or the students could opt-out of buying the Clicker and have their final exam be worth more (60% of final grade). Students had to inform the instructor at the beginning of the class of their chosen option. The final grade for the course consisted of a 11 online homework assignments (12% of final grade), two midterms (13% and 15% of final grade) and the final examination. No adjustments were made to the grades and the same grading procedure was applied to all students.

Section 1 in the Fall Term (September-December 2013) of the undergraduate statistical methods course had 227 enrolled students and 44 of those students opted not to buy and use a Clicker. Section 2 in the Winter Term (January-April 2014) of the undergraduate statistical methods course had 313 enrolled students, of which, 67 opted not to buy and use a Clicker.

In both the Fall and Winter Terms, all students attended 39 hours of in-classroom lectures. Students with Clickers answered questions that were integrated into a PowerPoint® presentation using the TurningPoint® technology. Students without Clickers were present in the classroom and observed the Clicker response results and were present for any further discussion of the content. It should be noted that students without Clickers were not asked to participate in the polling by raising hands or other methods but were, however, encouraged to engage in the discussion that followed the Clicker polling.

RESULTS

*Section 1: Fall Term*

In the Fall Term, 19.4% of 227 enrolled students opted not to buy and use a Clicker. Table 1 shows the resulting final grades for the course calculated for those students who used the Clicker and those students who opted-out of using the Clicker. Students that used the Clickers recorded a higher mean final grade at 68.32% compared to the students who opted-out of the Clicker whose mean final grade was 63.84%.

Table 1. Resulting grades recorded for the Fall Term students.

	M	SD	N
Clicker	68.32%	15.41%	183
Opt-out	63.84%	16.52%	44

A t-test (assuming heteroscedasticity) was performed to check whether the mean difference in the final grades of the students in the Fall Term who used Clickers and the students who opted-out were statistically different from zero at the 5% significance level (Table 2). Both one-tailed and two-tailed tests showed that the mean difference in final grades was not statistically different from zero.

Table 2. Comparing means for the Fall Term (t-test assuming unequal variances).

Summary

Degrees Of Freedom	62	Hypothesized Mean Difference	0.E+0
Test Statistics	1.63626	Pooled Variance	244.36384

Two-tailed distribution

p-level	0.10685	t Critical Value (5%)	1.99897
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One-tailed distribution

p-level	0.05343	t Critical Value (5%)	1.6698
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*Section 2: Winter Term*

In the Winter Term, 21.4% of 313 enrolled students opted not to buy and use a Clicker. Final grades for the course were calculated for those students who used the Clicker and those students who opted-out of using the Clicker (Table 3). Students that used the Clickers recorded a higher mean final grade at 69.87% compared to the students who opted-out of the Clicker whose mean final grade of 66.06%.

Table 3. Resulting grades recorded for the Winter Term students.

	M	SD	N
Clicker	69.87%	14.12%	246
Opt-out	66.06%	16.00%	67

A t-test (assuming heteroscedasticity) was performed to check whether the mean difference in the final grades of the students in the Winter Term who used Clickers and the students who opted-out were statistically different from zero at the 5% significance level (Table 4). The two-tailed test resulted in the mean final grades being not statistically different. However, the one-tailed test showed that the mean difference was statistically different from zero.

Table 4. Comparing means for the Winter Term (t-test assuming unequal variances).

Summary			
Degrees Of Freedom	96	Hypothesized Mean Difference	0.E+0
Test Statistics	1.76851	Pooled Variance	211.4223
Two-tailed distribution			
p-level	0.08015	t Critical Value (5%)	1.98498
One-tailed distribution			
p-level	0.04008	t Critical Value (5%)	1.66088

## CONCLUSION

Although both the Fall and Winter terms recorded lower means for final course grades by students who opted-out of using Clickers in the classroom, both terms showed no statistical differences in a two-tailed t-test ( $p > 0.05$ ) based on 227 and 331 students, respectively, in the terms. Therefore we can conclude based on these results, that the purchase and use of the Clicker devices in the classroom does not have an impact on the final grades of the students in the large undergraduate statistics course.

Despite finding no significant differences in final grades of those students who used Clickers compared to students who opted-out of Clicker use, Clickers could still be a valuable addition to the classroom. Students who opted-out of using Clickers were still present for the discussion that followed the Clicker poll. Perhaps the discussion that follows the Clicker polling is important for student engagement and not necessarily the ability to use Clickers in the classroom. Clearly further research is warranted to examine, not just the use of Clickers, but also the involvement of the Clicker pedagogy and its influence on final grades in undergraduate statistics courses.

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