Clicking Our Way To Class Discussion

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ABSTRACT

The goal of this research project is to investigate whether the use of a personal response system ("clickers") in the classroom increases student participation and discussion and its impact on the quality of the discussion in undergraduate accounting courses. While many studies conducted regarding the use of clickers rely on student surveys to determine the effectiveness of using clickers, this study will add to the literature by providing evidence of actual student behavior as it relates to participation when clicker technology is used in the classroom. Our study includes collecting data on student classroom behavior by observing and measuring the level of participation in both clicker and non-clicker classes. We discuss the observed impact of clickers on class participation and contrast it with prior work on the perceived impact, the use of clicker technology versus a clicker question, and the impact of the clickers on the faculty participating in this project.

Keywords: Clickers, personal response system, classroom technology, student engagement, student participation

1.   INTRODUCTION

*S*tudents must be active participants in the learning process, not passive recipients of information… Learning by doing should be emphasized… Creative use of technology is essential… Accounting courses should not only focus on accounting information. Teaching methods that expand and reinforce basic communication, intellectual and interpersonal skills should be used…" This mandate was issued in 1990 by the Accounting Education Change Commission (AECC) as outlined in "Objectives of Education for Accountants: Position Statement Number One". Furthermore, the idea of actively engaging students in the learning process has been widely promoted and encouraged not only in accounting literature, but also across the disciplines. (Bonwell and Eison, 1991; Bean 1996; Sutherland and Bonwell, 1996; Johnson, Johnson and Smith 1991).

The goal of this research project is to investigate whether the use of a personal response system ("clickers") in the classroom increases student participation and discussion and the quality of the discussion in undergraduate accounting courses. While many studies conducted regarding the use of clickers rely on student surveys to determine the effectiveness of using clickers, this study will add to the literature by providing evidence of actual student behavior as it relates to participation when clicker technology is used in the classroom. Our study includes collecting data on student classroom behavior by observing and measuring the level of participation in both clicker and non-clicker classes. In our findings, we discuss the observed impact of clickers on class participation and contrast our findings with prior work on the perceived impact of clickers on participation, the use of clicker technology versus a clicker question, the impact of the clickers on the faculty participating in this project, and student culture issues related to participation.

2.   LITERATURE REVIEW

The idea of actively engaging students in the learning process has been widely promoted and encouraged not only in accounting literature but also across the disciplines. (Bonwell and Eison, 1991; Bean 1996; Sutherland and Bonwell, 1996; Johnson, Johnson and Smith 1991). Yet, one of the most challenging tasks for an educator is to get students to understand that they must actively participate in their own learning process. Too often students will not participate due to a variety of reasons, such as fear of ridicule by classmates, the lack of self confidence in their

abilities in various subject areas, lack of preparation, and student culture regarding classroom participation and other dynamics.

To better engage the "Net Generation", who have grown up with technology in all aspects of their life (Robinson 2006), many institutions of higher education have made substantial investment in incorporating the use of Personal Response System technology (PRS or "clickers") into their classrooms (Bode *et al.,*2009). Clickers have been found to improve classroom interaction (Hockstra 2008,Sanders 2007, Zhu 2007) with students more engaged with course content (Robinson & Ritzko 2006, Bode *et al*., 2009), while promoting a more learner-centered, active learning environment as compared to traditional, passive learning, lecture-based instruction(Hoffman & Goodwin 2006, Caldwell 2007). Each student has the opportunity to respond electronically (often times anonymously) to a multiple choice question(s) posed by the instructor, thereby creating a more active classroom environment where every student has a "voice" (Rodgers & Starrett) that can be "heard" via the histogram projected on the media screen summarizing the responses of the class. Therefore, clickers offer everyone an opportunity to participate in a lecture regardless of whether there are 20 or 500 students. As (Canaghan & Webb 2007) states "A benefit of Group Response Systems is that they may increase interactivity, regardless of class size, by having all students immediately respond to and receive feedback for every question".

With respect to classroom dialogue, Draper (2006), found clickers critical to facilitating discussion when the teacher did not reveal the correct answer but rather instructed students to discuss the answer with their peers. Hoffman & Goodwin (2006) experienced more questions from clicker students than non-clicker classes, whereas, several studies acknowledged through student self reporting, that students were more likely to participate if their answers were anonymous which enhanced self confidence.(Bode *et al*., 2009, Elliott 2003, Beekes 2006). Conversely, Canaghan & Webb(2007) found that while students enjoy using clickers, students in the clicker classes interacted less with their professors by asking few questions (Taylor 2007). "It actually suppressed verbal participation" (Taylor, pp.2). Canaghan & Webb (2007) speculates that students in the minority who answered incorrectly are intimidated and want to save face in front of the correct majority and therefore, don't ask questions. These findings are in conflict with the expected outcome if clickers do in fact increase student engagement.

While the literature reviewed generally supports the 80% clicker satisfaction rate reported by student surveys in the United States and Canada (Taylor 2007), there is hardly a consensus as to the effectiveness of clickers on student learning. While some research has found that students using clickers achieve higher exam scores (Conoley *et al*.,2006, Reay 2005, Mayer 2009), several studies indicate either a modest to no significant increase in achievement test performance when clickers are used (Morgan 2008, Lasry 2008, Canaghan & Webb 2007, Nelson& Hauck 2008, Morling 2008, Stowell & Nelson 2007).These mixed results suggest that there is limited evidence to support the expectation that clickers provide a supplemental learning benefit to students. Interestingly however, students self report that they believe that clickers improve their learning (Zhu 2007, Bode *et al*., 2009, Canaghan & Webb 2007, Conoley *et al*., 2006,). Canaghan & Webb (2007) intimate that this dichotomy can be explained by the 'Halo Effect' of student satisfaction with the clicker technology creating a belief that clickers improve their learning.

Clickers can be used to achieve a variety of pedagogical goals including assessment of student comprehension, and to provide feedback to both the student and instructor. The immediate feedback provides vital information on where the lectures have missed their target and where the students' level of knowledge stands. (Murphy & Smark 2006). This feedback allows the instructor to adapt and re-direct their lectures appropriately. (Cunningham 2008). While the clicker feedback is most helpful, there is general consensus that clickers eat up valuable class time resulting in a decrease in course content coverage (Caldwell 2007), which is often considered to be more than compensated by a perceived increase in student engagement, with immediate feedback to the instructor on student challenges and the ability to assess if the tempo of the course is appropriate.(Elliott 2003).

Much of the literature on clicker technology includes the use of self reported student surveys as the assessment measurement tool, while acknowledging the need for further investigation of actual student behavior as it relates to the use of personal response systems. (Robinson 2006, Robinson & Ritzko 2006). With the lack of consensus regarding the impact of clickers on student learning and the limited observable and measurable assessment tool data, further research in this area has been encouraged (Canaghan & Webb 2007, Hoffman &

Goodwin 2006). Our study includes actual observation of class participation, and thus seeks to begin to fill that gap in the prior research related to clickers.

3.   METHODOLOGY

As noted in the literature review, few clicker studies have included direct observation of sections taught by the same professor, one of which used clickers and one of which did not, and that became the focus and design of our study.   During the Spring 2009 semester, two professors and students in four separate sections were simultaneously participating in the project, 2 sections of an Intermediate Accounting course and 2 sections of a Managerial Accounting course. Each course has a clicker section and a non-clicker section, and both sections of each course were taught by the same professor. For each course, a student observer was provided an observation sheet and observed both the clicker and non-clicker sections. Student observers were provided training on how to complete the observation, and on the observation sheet.

Demographics

The university is a private, residential, primarily undergraduate, religious-affiliated university in the Northeast, of approximately 3,800 students. The professors teaching the two courses have 19 and 10 years experience at the institution, and both have taught the course observed several times before. Basic demographics of the classes are provided in Table1.

Table 1: Demographics of Courses

Course Characteristics	Managerial Accounting		Intermediate Accounting	
	Required for all business majors – typically taken in freshman or sophomore year.		Required for all accounting majors. Typically taken in sophomore or junior year.	
	Clicker	Non-Clicker	Clicker	Non-Clicker
# of Students Enrolled	13	15	22	22
Gender Male% / Female %	42%/58%	62%/38%	77% / 23%	68% / 32%
Major Accounting %, Other %	8% 92%	8% 92%	95% 5%	77% 23%
Class Year	2011-25% 2012- 75%	2009-8% 2010-8% 2011-8% 2012-76%	2009-5% 2010-55% 2011-40%	2009-5% 2010-32% 2011-63%
Average Course Grade	82.5	75.7	81.68	78.6

Observations

A "clicker question" related to course content for the week was presented to the students and discussed at the beginning of the class period.   As shown in Figure 1, the observation sheet provided the professors a framework for the review and discussion of the clicker question. During the observation, the observer noted the number of students present and the number who had the correct answer, how many participated in the various parts of the discussion (see items one through 4 in Figure 1), and other qualities of the discussion. The observation sheets were tallied using standard qualitative methodology (Miles and Huberman, 1994).

Figure 1: Clickers and Class Discussion Observation Data Sheet

Date: **START TIME:** _____

Type of Problem:
Number of Students Present: **END TIME:** _____
Number of Students with Correct Answer:
(Via Clicker Data or Observation Count)

	N/A	Number of Students Who Participate	Did the Professor prompt Students?	Do Students Add to What Others Have Said?	Is there an observable flow to the conversation?	Other Comments By Observer
1. What is the correct answer?						
2. A. Do you need to review the steps in the calculation?						
B. Do you have any questions about the solution?						
3. Why is the accounting for _____ important in business?						
4. Can anyone link this to something else we have talked about this year or link it to another class?						
Quality of Discussion To be ranked by observer and professor each time.		Very High		High	Low	Very Low

Survey Data

At the end of the course, each professor gathered survey data from both sections regarding the clicker questions. Questions explored students' perceptions regarding the clicker questions, and in the sections that used clickers, the use of the clicker technology was explored. Questions were based on a five-point Likert-scale, with 1=strongly disagree and 5 =strongly agree. Survey questions and means used in this paper are shown in Table 3. Because we have such small sample sizes, we use our survey data descriptively.

4.   DATA AND RESULTS

Observation Data

Table 2 shows that the clicker sections have a slightly higher percentage of students who had the correct answer.   With one exception – the percentage of students who wanted the correct answer for the clicker question reviewed in Intermediate Accounting – the clicker sections had higher or equal participation to the non-clicker section for both courses. Both courses had very few students who asked questions about the solution.

Table 2: Summary of Observation Data

This table shows the average number of students responding to the discussion questions presented by the instructor. Classroom observation counts are based on raised hands.

Discussion Question	Managerial Accounting			Intermediate Accounting		
	Average Responses- Clicker Section(1)	Average Responses- Non-Clicker Section(1)	Response Comparison	Average Responses- Clicker Section(1)	Average Responses- Non-Clicker Section(1)	Response Comparison
Average Number of Student With Correct Answer/Average Total Number of Students	6/12 50%	7/15 47%	Clicker Higher	7/18 39%	6/20 30%	Clicker Higher
1. Do you need to review the steps in the calculation?	2 17%	1 7%	Clicker Higher	3 17%	5 25%	Clicker Lower
2. Do you have any questions about the solution?	<1	<1	Same	<1	<1	Same
3. Why is the accounting for ____ important in business?	2 17%	2 13%	Clicker Higher	5 28%	3 15%	Clicker Higher
4. Can anyone link this to something else we have discussed this year?	1 8%	1 7%	Clicker Higher	3 17%	3 15%	Clicker Higher
(1) The total number of responses varied from total enrollment in Table 1 due to absences and tardiness.						

Survey Data

The survey data in Table 3 does not show meaningful differences between the clicker and the non-clicker sections, although several differences are worth noting. First, the Intermediate Accounting Clicker section responded more positively to the majority of the survey questions. In particular, the Intermediate Accounting Clicker section scored both participation questions (number 6 and 7) higher than the non-clicker sections, indicating support for prior research that clickers increase participation. The survey had room for comments, and ten of eighteen students commented that the clicker increased participation, and that the anonymity of the clickers reduced fear and or embarrassment of giving the wrong answer.

In Managerial Accounting, student responses were lower overall than in Intermediate Accounting. And, the Managerial clicker section did not consistently score higher than the non-clicker section as seen in Intermediate Accounting. Interestingly, on the two participation questions the non-clicker section scored higher than the clicker section, and non-clicker students commented the clicker questions focused and increased class discussion. Across all sections responses tended towards neutral, the midpoint on the 5-point Likert scale. Students on average did not strongly agree or strongly disagree with the clicker questions or clicker technology.

Table 3: Summary of End of Course Survey Responses

Mean value of student responses to Likert-scale questions differentiated by course and clicker vs. non-clicker class, where 1 is "strongly disagree" and 5 is "strongly agree".

Question	Managerial Accounting				Intermediate Accounting			
	Clicker Class		Non-Clicker		Clicker Class		Non-Clicker	
1. My professor was clear in why we were using the clicker questions	3.3	62%* Agree	4	90%* Agree	4.3	84%* Agree	4.2	95% Agree*
		23% Disagree		5% Disagree		5% Disagree		0% Disagree
2. The clicker questions clarified course material	3.6	62% Agree	3.6	67% Agree	3.9	79% Agree	3.8	73% Agree
		8% Disagree		14% Disagree		0% Disagree		5% Disagree
3. The clicker questions made me prepare more thoroughly for class	2.5	23% Agree	2.6	10% Agree	3.2	37% Agree	2.5	14% Agree
		62% Disagree		48% Disagree		21 % Disagree		55% Disagree
4. The clicker questions made the class more fun	3.2	54% Agree	2.8	24% Agree	3.9	84% Agree	3.2	50% Agree
		23% Disagree		38% Disagree		0% Disagree		32% Disagree
5. Valuable class time was taken up by using the clicker questions	3.6	69% Agree	3.3	52% Agree	2.8	26% Agree	2.1	0% Agree
		23% Disagree		33% Disagree		47% Disagree		77% Disagree
6. The use of clicker questions made it more comfortable for me to participate in class discussion	2.7	31% Agree	3.1	38% Agree	3.8	68% Agree	3.3	55% Agree
		46% Disagree		24% Disagree		5% Disagree		32% Disagree
7. The use of clicker questions improved overall class discussion	2.5	8% Agree	3.4	67% Agree	4.1	84% Agree	3.9	86% Agree
		46% Disagree		19% Disagree		5% Disagree		9% Disagree
8. I wish clickers were available In all my classes	2.7	15% Agree	3.1	33% Agree	3.4	42% Agree	3.9	68% Agree
		38% Disagree		14% Disagree		11% Disagree		0% Disagree
9. The clickers were easy to use.	4.3	92% Agree			4.4	95% Agree		
		8% Disagree				0% Disagree		
10. My professor utilized the clickers well by asking questions that worked well with the technology	3.0	54% Agree			4.3	100% Agree		
		31% Disagree						
* Percentages do not add to 100% because neutral responses are ignored.								

5.   DISCUSSION

Using Clickers to Increase Class Discussion

In discussing the findings of our study, we are making the important distinction between the results of the third party observable data and the self reported student survey data. While Draper (2002) found clickers critical to facilitating discussion when the correct answer was not revealed, our results were mixed. Despite the fact that the clicker sections have a slightly higher average number of students with the correct answer, when asked specifically about reviewing the clicker question and its solution, participation by the clicker section was lower for the Intermediate Accounting class yet higher for the Managerial class. Furthermore, our observation data indicates that the use of clickers did not increase the number of questions asked by students, which is contradictory to Hoffman and Goodwin (2006) who experienced more questions from clicker students than non-clicker classes. Our results do support in a limited way the findings of Carnaghan & Webb (2007) that clicker classes ask fewer questions (Taylor 2007). With respect to promoting classroom discussion and students willingness to participate when asked questions, our observable data indicates that for both courses the clicker section on average had a slightly greater percentage of students participate in discussing why the day's accounting topic was important for business and linking the discussion to a previously discussed concept or topic. This data lends support to the findings of Bode *et al*., (2009) and Stowell and Nelson (2007) that found students in clicker sections are more willing to participate in subsequent class discussion.

Students self reported as being neutral or slightly agreeing that clicker questions clarified course material (average response for all sections ranged from 3.6 to 3.0) and that the clicker questions made the class more fun (average responses ranging from 2.8 to 3.9). While our study does not attempt to directly measure the impact of clickers on student learning, our student responses are in line with the findings of previous studies where the 'Halo Effect' explains the dichotomy of the student belief that clickers do improve their learning although there is limited observable evidence to support the learning benefit of clickers (Zhu 2007, Bode *et al*., 2009, Carnaghan & Webb 2007, Conoley *et al*., 2006),

With respect to class participation, the Intermediate Accounting course responses support the findings of Robinson 2006, Robinson & Ritzo 2006, Bode et al., 2009 where students self reported that clickers increase class participation. Furthermore, 44% of the Intermediate clicker section commented that the best aspect of clickers is the anonymity of their response, "being able to answer a question anonymously without fear of having the wrong answer", which is in line with Bode *et al*., 2009, Elliott 2003 and Beeks 2006 . Interestingly, 44% of the Intermediate clicker class (and 19% of the non-clicker section) commented that the best aspect of clickers is the confidential feedback on how you answered the question in relation to your classmates. These comments indicate a very real concern the students have to "save face" in the class by not embarrassing themselves in front of the class by responding with the wrong answer. This in part explains the low participation rates in the class discussion for all sections.

Clicker Question Versus Clicker Technology

Surprisingly, the Managerial Accounting course had the opposite results from Intermediate Accounting with respect to class participation. The non-clicker class had a more positive response regarding whether clicker questions increase class participation, with comments such as "the clicker questions allowed me to participate freely" and "the clicker questions…got me focused". Carnaghan & Webb, 2007 found similar results that clickers do not increase student engagement. However, when the responses of the non-clicker classes for both courses are combined, 77% of the students agreed or strongly agreed that the use of clicker questions improved overall class discussion. These results beg the question; is it the process of asking the clicker question or the clicker technology that promotes student engagement? Perhaps the use of clicker technology impacts faculty approach, given the nature of the technology. And, it is the more focused discussion and testing faculty may adopt when using clickers that is impacting student engagement.

Impact on Faculty and Student Engagement

The clicker project added a new dimension to the classroom. One negative impact was the set up and use of technology. Students commented on this in the student survey. Despite the negative impact of the technology, the clicker questions had a positive influence on student engagement.

The process of engaging students with a clicker question that reviewed prior material did not need the use of clickers. As the weeks progressed, students became more enthusiastic and prepared to respond to the clicker question at the beginning of each class. This is true of both the clicker and non-clicker classes. This process was mutually beneficial as students got to see how well they had retained information and the instructor could gauge how effective the previous lectures were. The pedagogy of starting a class discussion with a review question seemed to work well with both courses for both faculty and students alike We also found that our structured format for discussion of the clicker question (Questions 1 through 4 in Table 2) were somewhat constraining for both faculty and students. These questions were necessary to effectively measure across courses and sections. In our future teaching, while the faculty involved will continue to use the clicker questions, they will not follow the more structured discussion format.

Student Culture Regarding Participation

While the use of clickers promotes 100% participation from the class, is there a downside to using the technology? Carnaghan & Webb, 2007 found that the use of clickers actually decreased student participation, especially when clickers had been used and were subsequently taken away. Do clickers promote a classroom culture where students become more comfortable with non-verbal participation? It is quite clear by the responses from the student survey in the upper level Intermediate Accounting course that students are more comfortable with the anonymous response so that they can avoid embarrassment by an incorrect response. Anecdotal data supports this student view. The third author was new to the university last year, and in student feedback and peer observation had been known for high levels of participation. As she was acclimating to the organization culture last year, the faculty member talked extensively with students. Students described part of the student culture as somewhat negative about active participation: whether or not a student knows the right answer or is making valuable points, other students will tease them about participation. The clickers let students avoid this. Such issues in student culture present interesting challenges as faculty try to promote highly active and engaged teaching and learning methods. Further, it is interesting that this view is present enough among students to be self-reported and then agreed about as valid, when such behavior would not be seen positively in other student contexts or settings (e.g., on an athletic team or in an academic club) or in the workplace.

6.   LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

A key limitation of our study is sample size. This study needs to be repeated with larger sample sizes. Another issue is the impact of the faculty and student learning curve for using clickers. Longer term use of and familiarity with clickers could impact the findings. We created the discussion guideline so that the discussion would be similar in both courses; however, even though the faculty who taught the courses helped develop it, the discussion format was constraining. This could be addressed by changes to the discussion format. Our study only uses descriptive statistics, and future work could use more sophisticated statistical analysis.

7.   CONCLUSION

What is most striking when analyzing the observable data versus the student self-reported data is that the observable data indicates a modest-to-no significant increase in participation when clickers are used, coupled with relatively low participation rates for all sections included in the study. However, the majority of both clicker and non-clicker classes agree (through self reporting) that the use of clicker questions improved overall class discussion and approximately half agree that the use of clicker questions made it more comfortable to participate in class discussions. What actually was observed in the class and what the students perceive are vastly different.

AUTHOR INFORMATION

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