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A Study Of The Impact Of An Electronic Classroom Response System On Student
Participation In Class Discussions And Response On Course Assessments.

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Abstract

The purpose of this study was to determine the impact that a classroom response system, often referred to as "clickers", had on student participation and overall student assessment. This quantitative study was designed to compare and contrast two classes of high school students over a semester time period. One of the classes was equipped with the clicker technology and used the devices frequently during the semester, while the other class had no access to the technology at any point during the semester. The three research questions that were used to guide this study were: How does the use of clickers in the classroom impact the extent of student participation in classroom discussions? How does the use of clickers in the classroom impact the quality of student participation in classroom discussions? How does the use of clickers in the classroom impact student learning of course content? The results from this study suggest that the use of clickers can increase student participation, but had no direct affect on the achievement level of a student. Results also showed that clicker technology did not increase the quality of classroom discussions when compared to discussions taking place in a non clicker classroom. This study can be useful for educators that are considering implementing a classroom response system into their classroom.

Dedication

To Chuck.

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Chapter 1

Introduction

1.0 "Any Questions?"

"Class, do you have any questions?" Instructors at all levels of education often end lessons with this question. While instructors believe that they are giving their students a chance to speak up, there is little evidence to suggest that the invitation is effective (Bloom, 1984). Today more than ever, students need some level of involvement and participation in class to help them reach their learning potential (Thalheimer, 2003). Productive classroom participation and healthy discussions can ultimately lead to higher student achievement (Yourstone, Kraye, & Albaum, 2008).

Student participation does not just mean listening to an instructor talk about a subject. Participation should come from a student being active in the classroom. When a student is given the opportunity to interact with the teacher, the potential for meaningful learning and content retention increases (Brophy, 1986). These opportunities often times are limited because of poor teacher planning or teachers that use primarily lecture based lessons. Lectures have the tendency to turn even the most eager students that enjoy participating in class into passive learners that are forced to sit and listen.

A student's academic achievement in a classroom could depend on many factors: fellow classmates, subject matter, and even feelings towards the instructor. Engaging a student in the daily lesson is often times looked at as the most important factor in academic performance (Carta & Greenwood, 1988). A student that participates in class and is involved can feel a sense of ownership in the lesson, which helps in understanding the material (Kulhavy, 1977).

Participation can be viewed at the whole class or individual student level. Hollander (2002) discusses the need to present participation expectations as a collective responsibility of the class rather than just an individual responsibility. Students that take the time to speak up in class can often stimulate other students to get involved in class discussions. Students that develop a comfort level in the classroom and with other students are more likely to participate during class time (Thalheimer, 2003)

1.1 The Problem

Getting students to participate in class may not always be the easiest task for even the most experienced instructor. Simply asking questions may not guarantee responses from students. Instructors need to look at the learning environment they are creating in their classroom and assess if they are providing participation opportunities for the many different types of learners (Kulik & Kulik 1988).

A quiet student is not necessarily a student that will perform lower than a more talkative student; it just presents more of a challenge to the instructor to get all students to want to join in during class discussions (Cordes, 1983).Getting an active learner, a student who can think on his/her feet and is comfortable speaking in front of other students, to respond in class may not be as difficult as getting a more introverted student to speak up.

Several factors are important when attempting to create an effective environment for class participation. The teacher is usually considered the most important instructional resource in a classroom, and the key to setting the tone for active participation from all students. Teachers who challenge students with constant questions about content have a

better chance of students understanding the material being taught (Frase, Patrick, & Schumer, 1970). Challenge does not necessarily mean focusing only on the correct answer. Teachers can also foster a comfortable learning atmosphere if they provide students with constructive feedback and take the time to explain wrong answers (Brophy & Everston, 1976).

A common approach for teachers working with large groups of students is lecturing. Teachers usually justify lecturing when classes are "large". However, lecturing has been found to be an ineffective way to teach students because a majority of the students have very few, if any, chances to interact with the teacher (Bloom, 1984). Student participation in lecture classrooms usually occurs when a teacher asks if there are any questions and then calls on the first student to raise a hand (Brophy, et. al 1976) This again creates a problem for the more passive, and at times lower achieving students to speak up while the more active students take the few opportunities to engage in some type of dialogue with the teacher (Maheady, Mallette, Harper, & Sacca, 1991).

Class size is usually viewed as the other vital factor in encouraging students to participate in class. The number of students in a class often dictates how a teacher approaches his or her class, and the techniques that will be used. Larger groups could demand more of the teacher's time to address the students as a whole class and take away from the individual student time. Students sitting in large classrooms may not be as eager to speak up when compared to smaller class sizes. In a class consisting a large amount of students, 30 or more, a majority of students are hesitant to respond in front of peers even if they are encouraged to do so by the teacher (Stones, 1970).

Lesson strategy is clearly affected by class size (Rice, 1999). Teachers that are responsible for a large number of students tend to avoid writing assignments or open-ended questions (Rice, 1999). While these types of assignments offer teachers the opportunity to give students more personalized and specific feedback, they also require a tremendous amount of personal time to correct. Teachers need to find a healthy balance between preparing meaningful and informative lessons, and developing classroom strategies where all students are provided the opportunity to not only participate but succeed.

For years technology has been considered a useful learning tool to help teachers prepare and present lessons (Gabriel, 2008). A technological device that is currently being used in classrooms is the classroom response system, informally known as "clickers". Clickers are hand-held devices that allow students to quickly and even anonymously answer questions that have been posed by instructors during class. While clicker systems can be purchased from companies such as Turning Technology, IRespond, and eInstruction, students can also use their cell phones as a clicker to accomplish some of the same tasks. Teachers can access sites like Poll Everywhere and Socrative to survey their students in similar ways that response systems do. Since the inception of clicker technology research has been conducted on the general value they add to the classroom, but this researcher found few controlled studies conducted at the high school level that compare student achievement and classroom participation. The research proposed here will provide much needed evidence on the effectiveness of clickers to promote classroom participation and enhance achievement at different levels of use.

1.2 A Technology Solution

In order to help students reach their potential in the classroom teachers need to use any means necessary. Technology is becoming a common tool in today's classrooms and teachers are discovering the value it has in daily lesson planning. Students at all levels, elementary through college, are in some capacity introduced or involved with some type of educational technology (Kryder, 1999). From personal computers and laptops, to online courses and cell phone applications, students and teachers are discovering new ways to both learn and teach daily lessons. Evidence exists that teachers can enhance the learning environment by using technology to empower students and make them feel more involved in the classroom (Ward, 2003).

Clicker technology may just be the tool that gives students more control of their learning environment. Clickers bring a game show type atmosphere to the classroom. Students use handheld units to answer questions presented by teachers. The student responses are transmitted by infrared or radio frequency signals to a receiver that automatically feeds the results into a computer database program. Once a student transmits his or her response the result is instantly tallied and the instructor can view them privately or display all the answers to the whole class. With clickers, instructors have the capability to look at individual students and questions to see how they scored and to identify problem areas (Blackman, Dooley, Kuchinski, Chapman, 2002). Instructors can also view the class as a whole to assess if the students are really getting the main ideas and understanding the material. Compared to other forms of classroom technology that only provide hardware to the students, clickers are used to assess student learning and understanding (Blackman, et. al 2002).

Technologies are often viewed as a panacea—the answer to all problems. Clicker technology may not be effective if students don't understand and accept that it is a tool to improve learning. A technology such as clickers has the potential to positively impact student class participation and improve learning, if the teacher and students are willing to embrace the technology.

1.3 Research Questions

This study will determine if the use of a classroom response system can enhance the amount and quality of students' participation in the classroom discourse, and positively impact their learning performance. This research will seek to determine if the use of clickers has any impact on students' class participation or their learning of course content. Specifically, this study will investigate a student's class participation and course performance in two different instructional settings in a high school Business Law class: a class in which the teacher uses clickers to facilitate and promote class discussions, which will be known as the Clicker Class, and a class in which the teacher uses traditional question-answer strategies to facilitate and promote discussion, which will be known as the Traditional Class. Class participation data and students' scores on class tests will be analyzed to address the following research questions:

When incorporating a Classroom Response System in a high school classroom:

1. *How does the use of clickers in the classroom impact the extent of student participation in classroom discussions?*

2. *How does the use of clickers in the classroom impact the quality of student participation in classroom discussions?*

3. *How does the use of clickers in the classroom impact student learning of course content?*

1.4 Significance of the Study

Students today are viewed as more active learners than in years past (Guthrie & Carlin, 2004). It is no wonder that students may be losing interest and get increasingly bored with traditional lectures given the stimulation offered in the world of "Face Book, You Tube, and Twitter" and the myriad other on-line offerings. It is also not surprising that students who are using more technology in their personal lives now expect and demand to see more technology in their academic environment (Kryder, 1999).

The impact of clickers in the classroom have been studied and have shown that students like using them (Caldwell, 2007), but this researcher found no studies that determined if clicker technology actually increases the quality of student participation. Clicking a button may be viewed as participating by some teachers, but does the participation continue after the button is pushed? Clickers may offer a means by which instructors can not only involve students in the learning process, but also motivate students to engage in meaningful classroom participation.

1.5 Limitations

The study results may not generalize to other courses that focus on different content areas or demand different student performances, such as a science or math class. This study will be conducted in a high school business law course—a course in which students will study several areas of personal and business law. Students will be required to take daily notes, participate in daily discussions, and be subjected to a variety of class assessments including quizzes, tests, written reports, and group presentations. Similarly, the age of the students in this study could be considered limitation. High school students

today are generally very comfortable with various technologies and not intimidated by them. The same is probably true for younger students and students of college age. However, as with students of all ages, comfort levels are dependent on access and use to technologies outside the school setting, which can directly relate to a student's socio-economic status and or the access they have to technology from their home.

Another limitation may be the use of one instructor in the research design. Both classes will be taught be the same instructor.   While the goal is to replicate each class with the same daily lessons there may be days when the pace of one class is different from the pace of the other class. The amount of discussion in either class could affect the amount of material covered on any given class day. The same material will be covered during the course of the semester in both classes but may not be covered on the same days or in the same depth. The same instructor will be helpful in offering consistency by teaching each class, each day on the same material cannot be assured.

A final limitation of the study is student accountability. All students will be expected to participate in class discussions over the course of the semester but since participation in not a part of the course grading system, some students may choose to not participate at any point during the semester.

1.6 Definition of Terms

The following terms will be used throughout the study:

Active Learner- student that is interacting with the instructor and classmates both verbally and non-verbally.

Active Participation Score- a student participation score rated in the range of 2-5 on the Classroom Participation Rating Scale.

Class Participation Rating Scale- Likert scale that will be used to score student participation during the semester on a scale of 1-5.

Classroom Response System Software- computer program that accompanies a classroom response system and is used to develop questions, create tests, generate graphs, or statistics of individual students or a class as a whole.

Classroom Response System- computer based system that allows instructors to poll students during class and store or display their results to assess student understanding of a particular subject or question.

Clicker Class- classroom that is taught by the instructor with the use of a classroom response system.

Clicker- hand held remote controlled unit used by students as part of a classroom response system.

Participation- taking part in a class, showing an interest either verbally or non-verbally.

Passive Learner- student that is not interacting with the instructor or classmates either verbally or non-verbally.

Passive Participation Score- a student participation score rated as a 1 on the Classroom Participation Rating Scale.

Student Achievement- measure of success in a classroom through assessments.

Traditional Class- classroom that is taught by the instructor without the use of a classroom response system.

1.7 Preview

This dissertation will consist of four additional chapters. Chapter two will explain the literature that helped provide the framework for this study including research in student learning, teaching methodologies, educational technologies, use of cellular telephones as clickers in the classroom, and student achievements. Chapter three describes the methods and methodological foundations of this study with information about the framework of the research, the students that participated in the study, the methods used to collect data, and the means by which the data was analyzed. Chapter four will explain the results of the analyzed data and provide a breakdown of the two classes used during the study. These results will be compared in several ways including student assessments, student participation, and teaching environments. The final chapter, chapter five, will explain the results as they pertain to the research questions. Chapter five will also look at the study as a whole and examines possible future research areas in student learning, how clickers can be used to enhance student learning, and effective teaching styles with clicker technology.

Chapter 2

Literature Review

2.0 Introduction

This chapter develops the argument that a student learning in a classroom response system based environment will participate more in class and achieve higher assessment scores.   Some present studies do show that students taking a more active role in the classroom feel more connected to the subject and retain content better (Hafner & Hafner, 2004). Research is needed to understand how all students in a classroom using classroom response units can be used to improve student participation and achieve higher grades. This chapter will review selected literature in class participation as it related to the research questions and research about the role that response system play in classroom instruction.

The purpose of this chapter is to help place this study in the context of the literature, explain the factors the study is based on, and identify areas where this study will contribute to ongoing dialogues in educational research. This chapter will examine the following areas: student learning, teaching methodologies, and educational technologies. Included in the research will be student participation and its effect on learning, how it can improve student retention, how to enhance participation, and effective teaching strategies when using classroom response systems..

This study is based on the constructivism learning theory. One of the basic beliefs of the constructivism learning theory is that knowledge is gained by experiences in the classroom (Lebow, 1993). Constructivism looks at each student in a classroom as an individual with specific learning styles and needs. Instructors teaching in these

classrooms need to find ways to address the needs of all the students and realize that learning is not always a "one size fits all" approach.

The constructivism learning theory also stresses the importance of a student's experiences as a valuable learning tool (Von Glasersfeld 1995). Students enter the classroom with prior knowledge in many areas based on things they have experienced in their everyday lives (Von Glasersfeld 1995). Finding a way to incorporate that knowledge into classroom learning is a challenging task, but one that both the teacher and student should embrace.

2.1 Student Learning

Students cannot be looked at as bottomless pits that teachers can just dump information in and expect them to retain and comprehend. Teachers need to be aware of the different learning styles of students and find methods that will motivate all students to learn. Klemm (2007) states that learning is not just the memorization of facts but rather a combination of skills to help a student retain information. A good teacher should find ways to tap into each student's skill set and hopefully get them curious about the material being taught.

Students have needs in the classroom and an important need is being able to communicate with the teacher. Students who are succeeding at a task may have a better chance of grasping the concept of a lesson. Boyd (1973) found that students who receive instant feedback from a teacher have a better chance of learning and retaining the course material. Chickering and Gamson (2002) state that contact between teacher and student to provide immediate feedback are vital for student retention. Guthrie (1971) notes that

students can improve their retention of material when provided with instant feedback on incorrect answers. Students don't just need to be told they are wrong, they need to know why they were wrong. Harper (2009) states that teacher feedback to students does not have to be complicated or confusing but instead should give students the opportunity to take responsibility for his/her learning.

Research shows that class participation has a direct effect on student learning and helps enhance teacher/student communication. A student that is active in the classroom and engaged with the instructor could get a better understanding of the material being taught (Frase, et. al 1970). The question is how do instructors get their students to participate in class. Often times only a few students will account for the majority of the student-teacher interaction. Karp and Yoels (1976) conducted a study in a class with 30 students and observed that over 50% of the class comments and responses came from only 3 students. Some may define listening as participating but this researcher believes that class participation involves being active in the classroom and engaging in class discussions with the instructor and other students.

Not all students willing participate in class. Some students may be hesitant to raise their hand in class to answer a question for the fear they are wrong (Stones, 1970). Providing a wrong answer in front of a student's peers can often take away from student participation. Stones (1970) found that over 60% of students interviewed said that they would be hesitant to respond with other classmates listening even if they were encouraged to do so by the teacher.

Students that are involved in establishing class learning goals have a tendency to be more motivated in the classroom and show a desire to learn compared to students that

are simply told the learning goals by the teacher (Hom, Murphy, 1983). It is important for students to perform at a level in order to meet the leaning goals of the class, which is why allowing students to provide feedback on the learning process is important. After analyzing many studies on student learning, Hattie, Biggs, Purdie (1996), believe that providing students with feedback on learning is one of the most important techniques to help students succeed in the classroom.

The teacher is not the only resource in the classroom. Today's students need to be able to both interact and learn in a cooperative environment. Often times students can benefit by simply collaborating with other students on the class material. Studies have shown that students that spend time in class working in groups, rather than sitting quietly, have a better chance of understanding the material being taught (Johnson, Johnson, Stanne, 2000). Cooperative learning can provides teachers with a means of addressing student questions in small groups rather than jumping from student to student which can be both time consuming and counterproductive.

While this researcher realizes that not all students retain and understand information the same way it is his belief that learning is a social interaction. The way a student develops knowledge of a subject can be looked at as personal experience (Tobin and Tippins, 1993).

2.2 Teaching Methodologies

The role of the teacher is changing and they can no longer be viewed as a provider of information in the classroom. Teachers are now considered a facilitator of information and someone that will share their knowledge with students through interactions instead of

only lectures (Thalheimer, 2003). Teachers that are willing to teach in this learning

environment must be constantly thinking of ways to present their lessons that will

engaged students of all learning styles and abilities.

Teachers can use many different teaching techniques to get their students

interested in learning. Rankin and Hoass (2001) believe that students prefer instruction

that stimulates more of their senses. Students that are just subjected to listening for long

periods of time can lose interest in the material being taught. Passive learners may get

very little from sitting quietly in lectures while listening to other students interacting with

the teacher.

Teacher and student communication in the classroom is important in helping

students succeed in the classroom. Not only do teachers need to be aware of how

students learn in different ways, they also must give students the chance to develop

answers on their own before receiving guidance from the instructor. Kulhavy (1977)

believes that students need to think about their answer first and formulate their own

thoughts before getting feedback from their instructor. Students need the opportunity to

grow in the classroom and develop their own reasoning skills. Learning may be difficult

if a student is constantly given the correct answer from the teacher without first giving

the student the chance to reflect and develop their own response (Kulhavy 1977).

Some believe that for a student to learn teachers must involve the student in the

learning process. Thalheimer (2003) believes that learning will not take place unless a

student is in some way participating in the answer. Participating in the answer could be

through class discussions to help a student logically think through a question or by

answering questions as a review in the middle of a lecture. Frase (1970) states that

students that are constantly asked questions about the subject matter have a better chance of retaining information.

Class size should not be a reason to keep students from participating in class. Cordes (1983) states that teachers can have a difficult time providing students in large classrooms the opportunity to participate. The challenge for even the most seasoned teacher working in front of many students is how to solicit responses from all students willing to speak in class.

Teachers should be constantly working and communicating with their students to assure that they understand the material before moving on to the next topic. Kulik & Kulik (1988) believe that more learning takes place with immediate feedback compared to delayed feedback. This suggests that students will retain more material if they understand at the given moment the answer to a question. Students may not get much out of hearing the correct answer to a question at a later date, such as the next class period which may take several days.

Teachers need to be supportive of their students' efforts even if their answer is not always correct. Teachers need to be careful to not only focus on the negatives when providing feedback to students. Students may ignore an instructor's advice if some constructive suggestions to help the students improve are not also mentioned (Harper 2009). Rewarding the effort of a student at times can be just as much as a valuable learning experience as getting the right answer.

Ward (2003) writes that classroom activities drive the learning process which in turn impacts a student's academic progress. Ward (2003) continues to state that the traditional classroom does not empower the students to be active learners. Lecture based

traditional classrooms provide for one sided learning as the teacher simply delivers subject matter to the students who are then tested on the material at a later time. Duncan (2006) brought up in his research the learning from lectures theory. Duncan (2006) stated that most students surveyed had a difficult time learning and retaining from an ordinary lecture. The results of one experiment showed that over 90% of students that were tested on material that was presented to them 15 minutes earlier in a lecture setting got the majority of the answers wrong (Duncan, 2006).

Teacher feedback is important to student learning, but part of the feedback should focus on positive recognition for areas a student is doing well in. Studies have shown that the quicker a student receives feedback from his/her instructor in the classroom the greater the impact on student learning (Kulik, Kulik, 1988). If this is the case then teachers need to provide feedback immediately in order to prevent or at least limit incorrect answers or bad habits.

Students that repeat something many times have a better chance of understanding what they are doing (Marzano, Pickering, & Pollock, 2001). Marzano (2001) states that students can achieve an 80% competency score if they practice a task at least 24 times. Teachers also need to focus on the importance of repetition in their lesson planning. Teacher awareness to student repetition can aid in planning and ultimately help achieve learning goals of the classroom.

2.3 Educational Technology

For years technology in the classroom seemed to be used in primarily two basic ways. The first, where students are learning technology as part of the course content, such

as designing a webpage or understanding a spreadsheet program, or when the teacher would use some form of technology to teach the course content such as showing a PowerPoint slideshow to deliver notes (Rankin, et. al 2001). There is no right or wrong way to use technology in the classroom. Just as many teachers will experiment with new lesson ideas it is just as important for teachers to try some of the technology currently available.

Technology is progressing at a rapid pace in many fields. In education there are countless opportunities currently available for teachers to take advantage of if they are so willing. Kryder (1999) suggests that as a student's use of technology outside of the classroom increases they become more "visually literate". Today most students are familiar with many various forms of technology. From cell phone applications, to tablets, and personal computers technology is not a foreign concept to students today. Teachers need to not only understand the tech trend with students, they also need to embrace the idea and find ways to use and capitalize on it in the classroom.

Positive results have been found in assessing student success in studies where teachers incorporate some form of technology into the classroom to address the learning goals of the class (Ringstaff, Kelley, 2002). The technology that is available today can help instructors that are looking to move to a more student centered classroom. Technology can also compliment just about any lesson that an instructor presently uses, or plans to develop for future classes. Teachers that dare to experiment with technology can open up countless resources to all students.

Creating a classroom that engages students can be a difficult task for even the most experienced teacher. Teachers need to use creative methods to reach their students

and not always rely on lecture based sessions. The potential of instructional technology to add value to the classroom has been recognized by higher education for years (Peled, 2000). Most teachers probably realize the value of adding technology to a lesson, but many teachers may be hesitant to embrace it.

The use of technology in a classroom can be an asset when teachers focus on giving students more control of the learning goals (Russell, Sorge, 1999). The right technology can be a valuable resource to a teacher no matter what their level of experience is. When incorporated correctly by the instructor using technology in the classroom it can not only help students learn but it can also motivate students and develop their problem solving and critical thinking abilities (Schacter, Fagnano, 1999). Technology can help students work in more cooperative activities and give them more freedom to make choices in their daily learning (Mize, Gibbons, 2000). Simulations and training software can help in motivating student learning too. Collins & Halverson (2010) state that simulation games used in high school classes can help in not only motivating a student but also in helping that student retain the material being taught.

If teacher feedback to students is looked at as a key to retaining class material (Boyd, 1973), then technology has the potential to be a great asset for a teacher when it comes to providing instant feedback in the classroom. Educational technologies have the capability to correct a student instantly and aid them from repeating bad habits. Instant feedback when compared to feedback at a later time, the next day, can be counterproductive to a student's learning needs. Technology has the potential to help students better comprehend what they are learning and recall important facts/aspects in

the future. Technology has the capability to aid in setting goals and learning objectives that meet both the needs of the student and the teacher.

2.4 Classroom Response Systems

Classroom response systems are not new to the classroom, response systems have been around in some form for more than 40 years (Roschelle, Abramson, & Penuel, 2004). Classroom response systems have been referred to as electronic response systems, student voting machines, audience response units, and personal response systems among others (Roschelle et. al, 2004). Today many teachers and students refer to a student response system simply as "clickers". While many studies have been done to look at the various ways that clickers enhance student participation there are few studies that explore the best teaching techniques when using clickers (Abramson, Rochchelle, & Penuel, 2004). Much has been written about classroom response units but the literature is spread out over many areas and could be confusing. Teachers that use clickers, or any technology, in the classroom should be sure that they plan the use of them to the learning goals of the class and subject content.

Hake (1998) conducted a study of over 6,000 students in both clicker and non-clicker classrooms and found that students using clickers scored 25% higher on exams. Hinde & Hunt (2006) studied classes and found that clickers increased student concentration and believed it was a valuable learning tool. Poirier and Feldman (2007) stated that when students in a larger class used clickers on a regular basis they had higher test scores when compared to classes that did not use clickers.   Stowell and Nelson (2007) found that there was no significant difference in classes that used clickers when

compared to classes that used polling and flashcards as means to participate.
Additionally, in a study that looked at over 50 studies of clickers used in classrooms
found varying results as to the success of students using clickers compared to classes not
using clickers, MacArthur and Jones (2008).

Like other researchers exploring the use of classroom response systems in the
classroom Wood (2004) believes in an interactive classroom between a teacher and
students to promote learning. Wood (2004) stated that students should not sit passively
during class time, and that instructors should not expect their students to reach their
potential if teaching occurs in the one sided traditional manner. Clickers may just be the
link to aid all students in reaching individual learning goals.

Duncan (2006) looked at two simple questions with different answers: How to
engage students? And How to determine if the students are learning what is being taught?
Duncan (2006) looked at the uses of the classroom response systems in today's
classrooms and some of the common mistakes teachers make when incorporating the
units into their classrooms.

Duncan (2006) describes a student's hesitation to raise their hand in class if and
when they don't know an answer or have a question. A student that is unsure of an
answer may not want to draw the attention of their classmates if they don't know the
answer. Classroom response systems are a tool to be used that will give all students a
voice in the classroom and take some of the stress away that comes with not being
completely sure of an answer (Duncan, 2006).

The methods used in Everett & Ranker (2002) study will resemble similar
comparative methods used in this study. Everett (2002) used six different classes in the

fall and spring semesters of 2000 and 2001 respectively to test the student's knowledge

and satisfaction with the instructor. Half of the classes were equipped with classroom

response units and the other half were not. Everett (2002) recognized that students

initially were apprehensive to the units but that the learning curve was small for students

to begin correctly working the handheld units.

Student reactions were tallied using post and pre class surveys. Everett (2002)

concluded that the majority of students agreed or strongly agreed with the use of

classroom response systems in the classroom and felt that the units enhanced the learning

environment. The majority of students also disagreed or strongly disagreed with any

questions that spoke negatively about the units in the classroom.

Ward (2003) found ways to use the classroom response systems to develop

student ownership in the learning process. With the classroom response units Ward

(2003) believed that all students could participate in class without the fear of

embarrassment associated with wrong answers. Ward (2003) showed that a teacher could

track the progress of all students in the class on a daily question-by-question basis to tell

which students were grasping the material and which were having difficulties. Ward's

idea of an instructor setting cumulative class goals that the class as a whole must work

towards was an effective use of the classroom response system in the classroom. By

setting goals Ward (2003) believed that students would take on an ownership in the class

and the overall learning process.

Wood (2004) had a "big brother" theory in relation to the classroom response

units. Since the units could be used to monitor student attendance and assess daily

responses from each student it seemed unlikely that an instructor would invest the time to

work with students individually. Like other researchers exploring the use of classroom response units in the classroom, Wood (2004) believed in an interactive classroom between teacher and students to promote learning. Wood (2004) states that students should not sit passively during class time, and that instructors should not expect their students to reach their potential if teaching occurs in the one sided traditional manner. Wood (2004) lists the classroom response unit's possibilities both during and outside of class time for instructors. The feature of classroom response units that allow instructors to view a breakdown of responses from individual students was a point that teachers planning on using these units in the classroom should know. Wood (2004) believed that classroom response units opened the door to more communication options for teachers and students.

2.5 Classroom Response System Alternatives

Educators wanting to use clickers in the classroom do not necessarily have to purchase a classroom response system. As the popularity of response systems have grown so have cheaper alternatives. Today teachers at many levels could use a simple resource that many students carry with them to every class, a cellular telephone.

It would be naïve for a teacher to think that most high school and college students don't come to class with a cell phone in their possession. As institutions try to struggle with how to approach limiting cell phones some educators are taking advantage of the technology. In students ranging in age from 12-17 as many as 78% own a cell phone and use it frequently during the day (Madden, Lenhart, Duggan, Cortesi, Gasser, 2012). If so

many students are possessing cell phones during class, teachers could benefit from

finding ways to utilize the phone as a learning tool.

Poll Everywhere is an example of a site that is designed to let students respond to

a teacher's question using their cell phone. Poll Everywhere is similar to a student

response system in the way questions can be created by the teacher, and results instantly

tallied and displayed for everyone to see. Data is stored and can be analyzed just like

response systems do but teachers do not need to purchase the database storage software

that most response systems require. Depending on the size of the class Poll Everywhere

can be set up for free or as little as $50, compared to response systems that could cost

approximately $1,500 to 2,000 to equip a classroom.

2.6 Conclusion

Study results do show that the use of clickers in the classroom help promote some

form of student participation, but it is this researcher's belief that more time needs to be

spent on the quality of participation that clickers produce. This study will explore the use

of clickers in classroom and assess the value of student participation that clickers produce

when incorporated into daily lessons. Chapter three will explore the methods used to

design the study and how the researcher questions will be answered.

Chapter 3

Methods

3.0 Introduction

This chapter describes the methods that were used in researching the effect of the class response systems on student participation and achievement. The study will seek answers to the following questions:

> *When incorporating a classroom response system in a high school classroom:*
>
> 1. *How does the use of clickers in the classroom impact the extent of student participation in classroom discussions?*
>
> 2. *How does the use of clickers in the classroom impact the quality of student participation in classroom discussions?*
>
> 3. *How does the use of clickers in the classroom impact student learning of course content?*

3.1 Research Design

The study was conducted using a comparative group research design. Two Business Law classes followed the identical syllabus, had the same course objectives, and were taught by the same instructor using the same daily lessons and assessments. The only difference between the two classes was that one class, the Clicker Class, used the classroom response system on almost a daily basis while learning the course material. The other class, the Traditional Class, did not have access to the classroom response system at any point during the semester. For this study the 8:20 class was known as the Clicker Class and the 11:10 class was known as the Traditional Class. The choice of the earlier class as the Clicker Class was made arbitrarily without knowledge of the students enrolled in either class. Mean ratings of student grade point averages prior to the start of

the study semester was analyzed to establish equivalence/comparability of the two class groups and used as a covariate if significant differences were found.

3.2 Study Setting

This study took place on the campus of a mid-sized high school located in the northeast. The high school has an enrollment of about 1,100 students in grades 9th through 12th. The student to faculty ratio is approximately 18 to 1, with an average class size of 22 to 25 students for most classes.

Two Business Law classes were used for this study. Both classes met five times a week for the entire 16 week semester. The classes were held on campus in the same classroom and met for one hour and twenty minutes each day. The first class met from 8:20 am to 9:40 am and the second class met from 11:10 am to 12:30 pm. The classroom had the capacity to seat 30 students each in their own desk and chair. The classroom was equipped with updated technology- PC/Mac format computer, video projector, video screen, and smart board. Students enrolled in the Business Law class were studying basic concepts in both personal and business laws. Through case studies, daily lectures, and class activities, students got a basic understanding of the legal system and what roles it plays in both their personal and future professional lives.

3.3 Study Participants

Business Law is offered as an elective course to any student in either their junior or senior year; there are no pre-requisite courses or grade requirements to enroll in the course. Enrollment into any elective course at this high school is determined by a first

come, first serve basis. Upper classman are usually given first choice when scheduling

classes and tend to get their choice of elective courses. Based on past Business Law

classes, student enrollment for each class was expected to be in a range anywhere from

18 to 30 students. While all classes in this high school are capped at a maximum of 30

students there is no minimum number required to roster the course. The age range for

students in either Business Law class was expected to be from 16 to 18, and be a random

mix of male and female students. Students that do enroll in Business Law classes come

from all majors and levels, advanced, general, learning support, and usually have a wide

range of academic abilities.

3.4 Treatments and Controls

The following sections will describe the role of the instructor involved in the

study and the format of the classrooms that were to be used for the study.

3.5 Instructor Factor

The researcher served as the instructor for both the Traditional Class and Clicker

Class sections. The researcher holds a Bachelors Degree in Business Administration and

a Masters Degree in Education. The researcher has 19 years of teaching experience at the

high school level and has taught at least 2 Business Law courses per year for the past 16

years, continually refining and updating the content.

The researcher has experimented with the clicker technology at both the high

school and collegiate levels. In the high school classes the clicker technology was used

as part of a demonstration set sent from an educational company as a trial basis for a

portion of the semester. The technology was used on a trial basis for a four-week period

and incorporated into one Business Law class during the trial time. The clickers were

used in a random fashion and mainly for open ended polling questions.

The researcher's experience with the clicker technology continued with a 16 week

pilot study comparing two Business Strategy classes at the undergraduate level at a local

university. The clickers used for the pilot study were from the eInstruction Company and

will be the same clickers used for the proposed research. The pilot study was conducted

to test the various features of the clickers and get familiar with the clicker technology, but

also to identify observation categories that will be used in rating student classroom

participation in the proposed study.

This pilot study lead to a presentation and article (Matus, Summa, Kuschke, 2011)

that was helpful in working out a more efficient observation and grading scale for the

high school study.

The pilot study was also an asset in helping develop the Class Participation Rating

System. This Likert rating scale was developed to help assess and place a value on

student responses made during class. The Class Participation Rating System will be

explained in detail in section 3.13.

3.6 Traditional Class Strategy

The Clicker Class served as the comparison group for the Traditional Class. The

Clicker Class followed the exact same syllabus and format as the Traditional Class except

for the use of the classroom response system. Students in the Traditional Class did not

have access to the classroom response system at any point during the semester. Students

in the Traditional Class were taught the same material as the students in the Clicker Class

and heard the same daily lectures, and did the same activities and assessments.

Traditional Class students were prompted and invited to participate daily in any and all of

the following activities: daily discussions, chapter reviews, chapter tests, a case study

paper, and group presentations, but did so without the use of the classroom response

system.

The researcher used a variety of methods to stimulate discussions and allowed all

students the opportunity to participate daily. The course content was set up to promote

and encourage student participation. As material was reviewed each day in class the

researcher provided time for student input and feedback. In order to give each student an

equal opportunity to speak in class a "student numbering system" was used to call on

students, rather than allowing the same students to monopolize class time.

Each student was assigned a number by the instructor on the first day of class.

This number was used to determine which students would be called on to answer

discussion questions when students do not volunteer responses. On any given class day

the researcher would randomly select 3 to 5 student numbers. For example, at the

beginning of class on Monday students 2, 9, 16, 17 and 25 could be called on to answer

questions or provide feedback to a statement if no student volunteered an answer or

comment, or if only the same student(s) continued to volunteer and dominate the

discussion. On Tuesday students 7, 8, 16, 18 and 23 could be selected for participation.

If a student was absent when his/her number was selected, a sixth student would be

drawn. Again, the numbers were to be used only when no student volunteered or when

one or two students appeared to be dominating the discussion. The random number

system would also ensure that the instructor did not fall into a pattern of seeking responses from the same students during the semester.

3.7 Clicker Class Strategy

In this study the Clicker Class used a classroom response system for the semester. For the study students were not required to purchase a classroom response system remote control answer pad, all devises were provided by the researcher.

The clicker units used for this study were handheld devices that contained a 12 button response pad. The units would send an infrared signal to a USB receiver that was connected to the classroom computer. The software that accompanied the units allowed the instructor to create multiple-choice questions with the option of up to five answers. Yes/No and True/False were also possible question formats. The instructor also had the option with the database software to create mathematical and essay format questions, but neither question type was used for this study.

The classroom response system was capable of storing data pertaining to each individual student and to an entire class. The data was stored on the instructor's computer and could be used in many ways to aid the instructor. The instructor could see individual student results on a daily basis, as well as overall class results for the semester. The software that accompanied the system could easily display results in graph form to show what percent of questions were answered correctly on any selected day. Tests and other assessments could also be administered to students via their individual clicker. While individual student assessments and exercises could be tallied and stored, at no

point did any participating students in this research have their results displayed or made available to anyone outside of the study.

In the Clicker Class students were assigned a response unit on the first day of class. All units had a specific number that was used to identify each student. All units were brought to and from class each day by the instructor. Students picked up their assigned units at the beginning of each class and returned them at the end of class. Students kept the same unit for the entire semester. Students in the Clicker Class were actively using the units most days in class to participate in any or all of the following activities: class discussions, chapter reviews, chapter tests, and group presentations.

Similar to the Traditional Class strategy, the researcher used a variety of methods to stimulate discussions and allow all students the opportunity to participate daily. The researcher supported all students that choose to speak up at any point during class. While the clicker technology served as an instrument to encourage students to participate daily, it was also used in several ways to get students involved during class. The response system had a "Pick a Student" feature that could be used to call on a student at random. This feature was used in a similar way that the "student number system" was used in the Traditional Class. At any point during class the instructor had the capability to call on a student by clicking the "Pick a Student" icon. Students knew their pad number but did not know the order in which they could be called on with this feature. The use of the "Pick a Student" feature made it easier to select a student and allowed all students the opportunity to participate in class. As in the Traditional Class, all students in the Clicker Class would be allowed to speak up at any point during class regardless of the number being selected by the program. The feature's primary use was for the instructor to call on

a student when no student was raising his/her hand to respond or if the same few students seemed to be dominating the discussion.

3.8 Data Sources

The following sections will describe the forms of student participation that were used and analyzed during the study.

3.9 Student Class Participation

The instructor used daily discussion questions in both strategies to begin most classes. The questions were designed to get students thinking and participating at the beginning of class. Discussion questions were either open ended with no correct answer, e.g., "Which would you prefer your company to be, #1 in sales or #1 in profits?" or closed with a correct answer, e.g., "Which of the following fast food franchises was #1 in sales the past year- Burger King, McDonalds, Wendy's, or Subway?"

In the Clicker Class strategy students would respond to the daily discussion questions using their individual response units. The instructor would verbally ask the daily discussion question and then display the question on the projector via the classroom response system software (Figure 3.1).
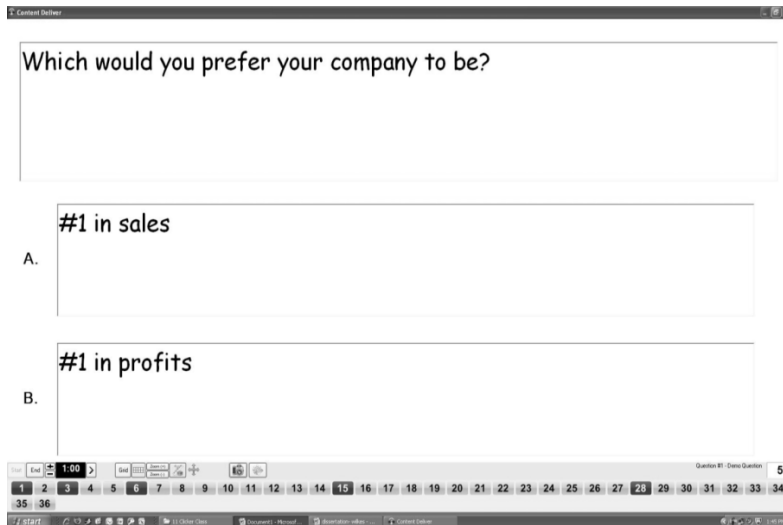
Fig 3.1: Open ended question using eInstruction software.

Students were given a moment to think about their answer and decide which

answer was the best or correct response. The system would then engage the clickers and

allow students to submit their answers. For this study the term engage meant that the

question has been displayed to the students and the software was now ready to accept the

submitted answers. Once a question was engaged a student grid (Figure 3.2) would

display on the bottom of the screen and show when all the students had entered a

response.
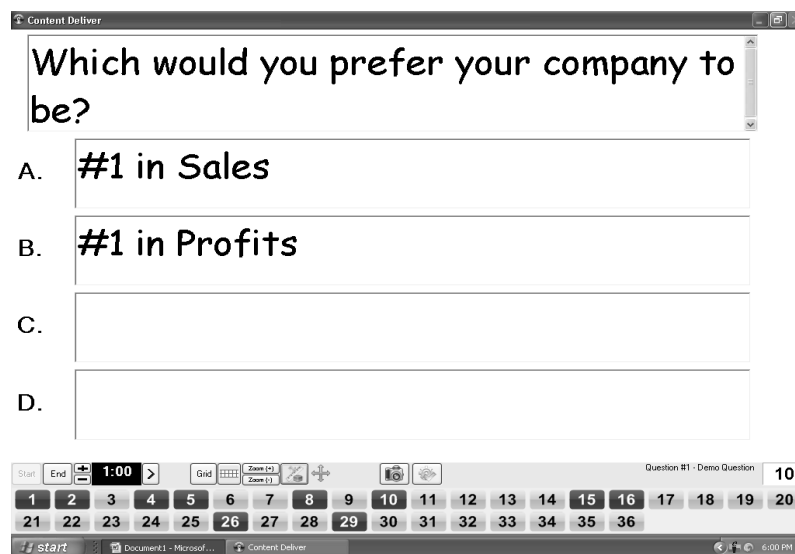
Figure 3.2: Student response grid. Blue numbers indicate that student has entered
a response to displayed question.

Each student's clicker number would turn blue once a response was entered. After all the students had submitted their response the session would end. Ending a question meant not allowing the clickers to transmit a response. Once the question session had ended a class breakdown of each possible answer and if applicable, the correct answer to the question was display on the screen (Figure 3.3). While the software had the ability to see each student's response, no individual responses would be displayed, just the total numbers for the possible answers.
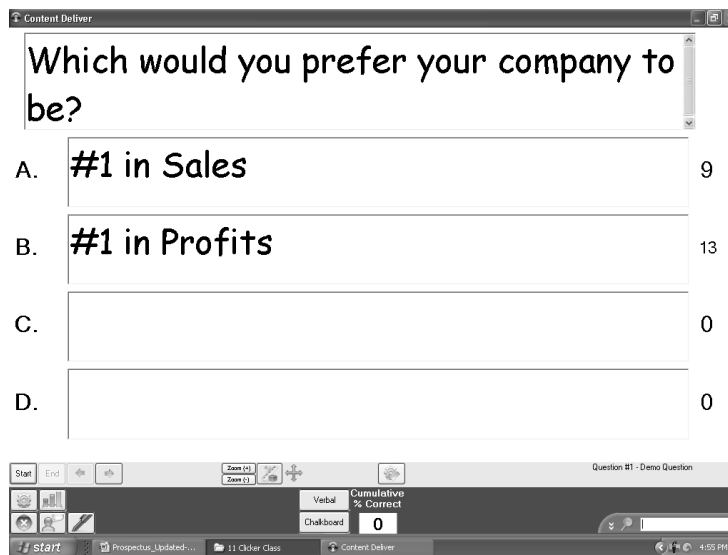
Figure 3.3: Breakdown of responses to displayed question.

After a question was answered and displayed, the response data from the students was used as a starting point for continued class discussions. The clicker units were used to get the students thinking and answering every question in hopes of provoking continued discussions. The instructor used follow up questions to challenge students to explain the reasoning for their answers and why they thought a choice might be right or wrong. The instructor would solicit student responses and use the "Pick A Student" feature if no student volunteered a response to the follow up question or if the same few students continually volunteer. All student responses and comments made during these

sessions were recorded and rated using a rating system designed for this study. The Class

Participation Rating System will be explained in detail in section 3.13.

Students in the Traditional Class would also have daily discussion questions

presented to them. Similar to the Clicker Class, in the Traditional Class the instructor

would verbally ask each daily discussion question and then project it on an overhead

screen. Students were given a moment to think about the question and then asked by the

instructor to provide an answer or feedback relating to the question. All students were

encouraged to participate and offer their views on the question presented. When a student

was called on and offered his/her feedback on a question the instructor would continue

the dialogue with that student and also seek additional comments from other students.

The instructor would solicit student responses and used the student numbering system

design if no students were volunteering on their own or if the same few students

dominated the discussion. All student responses and comments made during these

sessions were recorded and rated with the rating system mentioned explained in section

3.13.
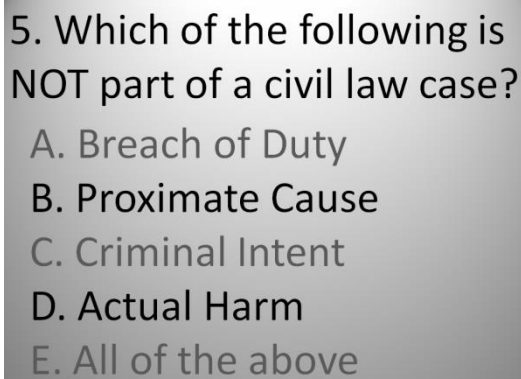
3.10 Chapter Review Participation

Chapter review questions were used at the end of each week to assess student

learning on all the course content covered in the previous chapter. On average, the

instructor would cover the necessary material in any chapter in five to seven class

periods. All review questions presented by the instructor were taken directly from the

chapter notes and class lectures. Review questions would be similar, but not the same, as

the actual test questions. Review question sessions were used to discuss previously

reviewed class material and allow students to ask questions or clarify any areas of

confusion. The review questions were the same for both the Traditional Class and Clicker

Class. In both classes the instructor would display the question and encourage the

students to discuss the reasoning for their individual responses before revealing the

correct answer.

In the Traditional Class each review question was projected one by one to the

class in the form of a PowerPoint slide (Figure 3.4).

5. Which of the following is
NOT part of a civil law case?
A. Breach of Duty
B. Proximate Cause
C. Criminal Intent
D. Actual Harm
E. All of the above

Figure 3.4: Review question displayed in PowerPoint slide format

Students were given a chance to read the question and five possible answers.

After all students were given a chance to consider each question and discuss their rational

for any answers, the instructor would verbally reveal the correct answer. Students were

not required to tell or show their answer to any question. Unlike in the Clicker Class,

students in Traditional Class did not know the other student responses, or were able to see

a breakdown of the responses for each answer.

Since students were not asked to reveal their answers the instructor would not

know the percentage of students that were correct for any review question. After the

answer to each question was displayed the students were asked if they had any additional

questions before moving on to the next question. The instructor would constantly ask

students if they had a specific question or if they would like an answer explained to them

during the chapter review session. At any point during the review session the instructor

would use the "student numbering system" to call on a student for his/her reasoning for

an answer. Any question or remark made by a student at any point during the review

session was recorded and rated.

In the Clicker Class all review questions were entered into the classroom response

system database prior to each class. During class each question was projected one by one

to the students (Figure 3.5).
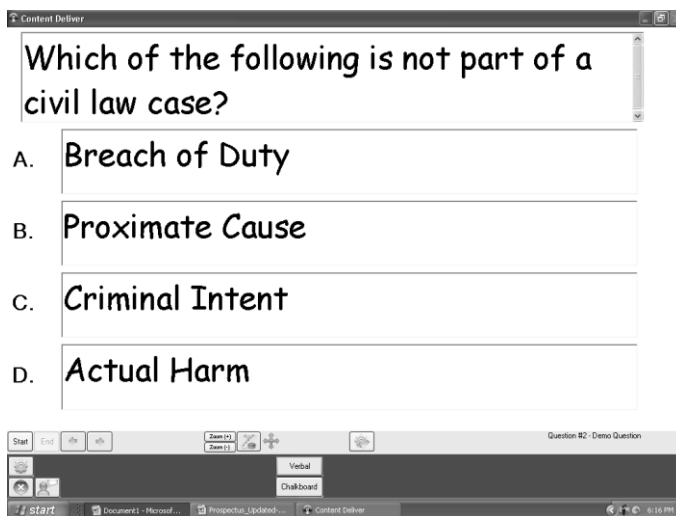
Figure 3.5: Review question format

Students were given a chance to read the question and the five possible answers.

The question was then engaged and each student would enter their response using their

personal clicker unit. The question would close after a sufficient amount of time was

given for students to respond. Student responses were monitored by the class answer

grid, all students would be encouraged and were expected to submit their answer. While

all students were expected to submit their response to each question it was not required.

Once a question was closed all student responses were recorded in the classroom response system database and the class totals were displayed on the screen with a numeric breakdown of each answer (Figure 3.6).
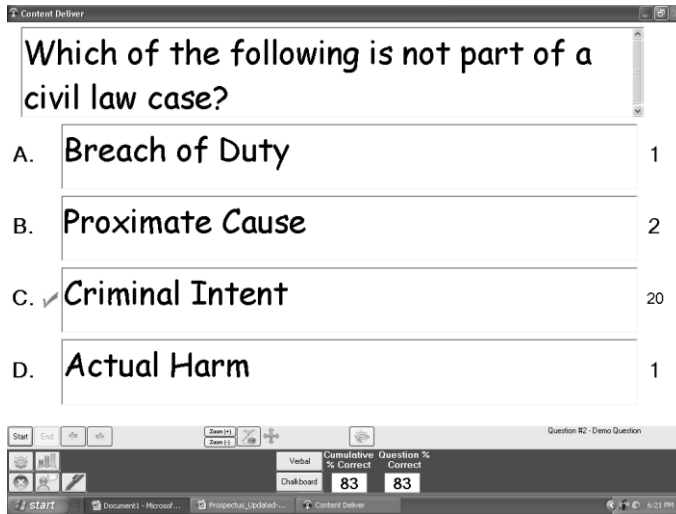
Figure 3.6: Review question answer breakdown. Numbers on the right represent the responses for each answer.

From the breakdown displayed on the screen each student would instantly know if they selected the correct answer. The instructor would also get an immediate display of what percentage of the students selected the correct answer. After each review question was asked and answered the instructor would determine if any material needed to be reviewed in class before moving on to the next question. The percent of correct answers was displayed at the bottom of the screen after each question was ended (Figure 3.7).
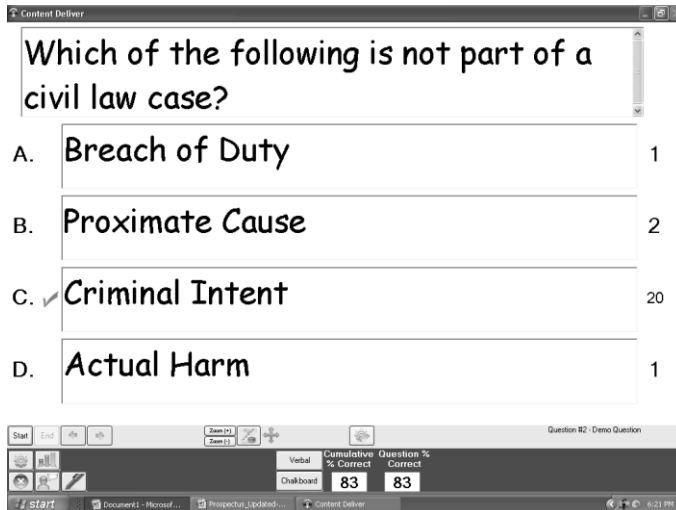
Figure 3.7: Percent of students that answered the question correctly.

The instructor would review the correct answer for each question and take the time to explain any areas that needed additional explanation. The instructor would also solicit additional questions from the class to assure there was a complete understanding of the question. The instructor would ask the students if there were any additional questions before moving on to the next question. Throughout the review session the instructor would use the "Pick a Student" feature to call on a student for his/her reasoning for an answer. All questions and comments made during review question sessions were recorded and rated.

3.11 Group Presentation Participation

Students in both the Traditional Class and Clicker Class classrooms were required to be part of a four-person group and to make a presentation on an assigned company. The instructor at the mid-point of the semester assigned student groups and companies randomly. Once groups were assigned, each group was given a specific company to research and a date to present to the class. Group presentations would begin after the 5th test was taken and in the two weeks prior to the final exam. Group presentations were

part of the Consumer Protection section of the class. Each group was assigned a company that committed some type of consumer violation or financial fraud, e.g. Enron Corporation. Part of each presentation was requiring the group members to look at what the company did wrong and how it hurt the employees or investors of that company.

Participation of the student audience for each group presentation was rated and scored using the same system and procedures applied in the daily class sessions and the chapter reviews session. The format for the group presentations was the same in the Traditional Class and Clicker Class settings: groups were given up to 25 minutes to make a presentation and up to 15 minutes was scheduled for student audience questions and comments. However, no clickers were used for this activity in the Clicker Class setting and the instructor assumed a different role from the daily class or chapter review sessions. In this way the participation data gathered following the group presentations would represent a pure measure of student participation, not fettered by technology or dominated by a teacher.

In both class settings the instructor would manage the presentation and response times, but the instructor would not ask questions or make comments about the group presentations. Instead, the instructor would ask the students to volunteer questions or comments in the follow-up period to the presenting groups. The use of the random student participation strategy used in the daily class and chapter review sessions was used when students in the audience failed to step forth with questions or comments, or when it appeared that the same few students were doing all the talking. Again, all student questions and comments from the student audience for the presentations were recorded and rated.

3.12 Instruments

The following sections will describe the design, use, and scoring system of the

Class Participation Rating System that was used for this study.

3.13 Class Participation Rating System

Student responses and comments offered during class discussions were rated or

scored using the Class Participation Rating System (CPRS) on video records made of all

class sessions in both the Clicker and Traditional classes. The rating system was designed

to assign a score to students that participate during class time. The following is a

breakdown of the scoring categories:

Class Participation Rating System -Likert Rating Scale

Score	Reasoning/Example
0	Student did not participate in class. No comments or gestures made.
1	Student responds to an instructor question directed at a group or the whole class with a short answer (yes, no) or a non-verbal answer (e.g. raising hand; nodding head, etc), or student responded with clicker unit.
2	Student responds to an instructor question addressed specifically to the student with a short verbal answer (e.g., yes, no, civil law, etc).
3	Student responds to an instructor question with an elaborated answer or explanation (i.e., more than one or two words from recall).
4	Student volunteers comments or elaborations in response to instructor comments or feedback that are not stated as a question to students.
5	Student volunteers comments or elaborations in response to comments made by another student.

3.14 CPRS Scoring System

Ratings from the Class Participation Rating System were translated into class participation scores. Rating records were assigned for each student individually by name during the actual rating (class time), but were then translated later into a random identification number to ensure anonymity of the students. Ratings done during class were recorded on either paper scoring sheets or directly into a computer database. Student questions, responses, comments, and remarks were extracted from the video recordings of the class session made during the observations. The videos were used to provide specific examples of the class discussions to supplement the analyses of the Class Participation Rating System data. At no point in the reporting of this study were student's name used or referenced.

Individual student participation scores were computed from all the Likert scale ratings (1, 2, 3, 4, 5) recorded for each student in each class observed. Thus, three student participation scenarios were possible: (1) a student "does not participate"—i.e., receives no CPRS ratings for the class period; (2) a student "participates passively, Passive Participation)—i.e., receives only CPRS ratings of 1 for the class; and (3) a student "actively participates", Active Participation—i.e., receives at least one Class Participation Rating System rating of 2-5 for the class. The following table, 3.1, shows an example of possible student participation ratings and scores for 20 students in a class. The table will show the scores of five students that received scores for passive and active participation, ten students that received only passive participation scores, and five students that did not receive any participation score during class.

Table 3.1
Student Passive and Active Participation scores for class session.

Student #	Student Name	Class Date	Ratings	Scores (PP/AP)
3	John	3/5/14	1, 1, 3, 2,3	2/8
18	Mary	3/5/14	2, 4, 4, 5, 1	1/15
9	Sue	3/5/14	1, 1, 1, 1	4/0
22	Sam	3/5/14	1, 1	2/0
15	Joe	3/5/14	1, 1, 1	3/0
*10 other students only raised their hands or hit the clicker once				10/0
**5 other students did not participate (received no CPRS ratings)				0
Total scores;				22/23

Passive Participation and Active Participation ratings were logged for individual students for all activities during the semester in both the Traditional and Clicker Classes.

3.15 Class Participation Rating System Implementation

A teaching colleague did the observing and assisted in rating student participation using the Class Participation Rating System. Class participation ratings were made based on a weekly random sample of at least three class discussions during the semester and on all the chapter review and group presentations sessions in both the Traditional Class and Clicker Class throughout the study. The researcher worked with the colleague to train him using live and video recorded sessions of the similar business classes in the 4 weeks prior to the start of the study semester. The training focused on direct comparisons of Class Participation Rating System ratings of the researcher and the teaching colleague using "near-point" comparisons to determine rater agreement. Video recordings of the business classes observed in the 4-week training period would facilitate discussion of agreements and disagreements. It was expected that the teaching colleague and researcher would reach 90% agreement prior to the data collection for the study. The 90% agreement number was a goal established by the researcher for this study. The video

recordings made during the training period would also be used to make weekly checks of intra-rater reliability during the semester long study, again using a near-point procedure to compute the reliability score. These weekly checks would guard against deterioration of rater reliability.

During the weekly rating checks the instructor and teacher evaluator would compare participation scores recorded during the week. If a discrepancy was discovered they would view the class tape to discuss what each of them observed and give justification for their rating. By following the rating scale established for the study the instructor and evaluator were able to maintain the 90% agreement throughout the course of the semester.

3.16 Chapter Tests

Students in both the Traditional and Clicker Classes were administered all chapter tests in the same format. While the clicker technology does allow for students to take tests with their personal units this feature would not be used during the study.

Students in both classes were required to take five tests during the semester and a final exam. Tests were spaced out during the semester and covered the following chapters: Test 1 covered chapters 1 and 2, Test 2 covered chapters 3 and 4, Test 3 covered chapters 5 and 6, Test 4 covered 7 and 8 and Test 5 covered chapters 9 and 10. The final examination was a cumulative test and covered all the chapters presented during the semester. All chapter tests were made up of 15 to 25 multiple choice questions and 3 to 5 short answer responses. Students were tested on the material covered during daily lectures and class notes. Each test was given on a pre-assigned date so

students knew in advance when a test would be given. In addition to knowing the test dates, students would also be reminded a few days prior to the test and encouraged to prepare.

All test work were be completed at each students' desk with the only materials needed being the answer sheet, pencil, and a hardcopy of the test. Students were given as much class time as needed to complete the test and were able to work at his/her own pace. The instructor would visually monitor all students during the test. Students could expect to see their test results with-in two to three class days after all students had completed the test.

3.17 Group Presentation and Report

In addition to students being part of a group presentation, students in both classes were required to submit a project report that summarized their specific company. While all group members were writing about the same company, all papers were the work of each individual student. All student papers were required to be submitted on the first day of the presentations; any papers submitted once presentations begin were penalized according to the course syllabus.

Papers from both classes were collected on the same day and mixed together to form one data set. Papers were then numbered for coding purposes and student names removed. The researcher was the only person with the coding key and the only identifying mark on any paper was the assigned number.

All papers were then given to a member of the instructor's department for blind scoring. The teaching colleague that did the grading of the project papers was different

from the colleague that assisted with the class participation scoring. The papers were

graded by the guidelines of the project scoring rubric that was created by the instructor.

Prior to grading, the rubric was explained in detail to the teaching colleague to eliminate

any confusion that may have come up during the grading process. The researcher and

grading colleague graded and discussed a sample of past project papers to establish

ground rules for applying the grading rubric. The grading colleague's intra-grader

reliability was checked to ensure the reports were being scored equally and all

assessments were fair to all each student. When all individual papers were graded they

were returned to the instructor and matched to the appropriate student.

3.18 Data Analysis

The proposed study generated two types of data: participation data and

achievement data. The participation data was derived from the collection of Class

Participation Rating System Likert Scale ratings across the various class activities (daily

discussion, chapter reviews and group project presentations). The test data was derived

from the chapter tests, the final exam and the written reports of the final group projects.

Prior to conducting any analyses of the participation or test data, the mean grade point

averages (GPAs) of the students in the Traditional Class and Clicker Class was subjected

to a t-test. The participation and test data was subjected to separate analyses to account

for the different forms of data (participation scores are ordinal and test data are

continuous). Both sets of data were subjected to ANOVA or ANCOVA procedures

depending on the outcome of the t-test of the GPAs. The ANOVA or ANCOVA

procedures would compare means (adjusted or not) for the Traditional Class and Clicker

Class groups.

3.19 Participation Data Analysis

As explained in 3.14, student participation, Passive Participation and Active

Participation, scores were computed from the Class Participation Rating System ratings.

Both of these scores were analyzed in answering the first and second research questions:

> 1. *How does the use of clickers in the classroom impact the extent of student participation in classroom discussions?*
>
> 2. *How does the use of clickers in the classroom impact the quality of student participation in classroom discussions?*

Student participation scores for both Passive and Active Participation were

computed for individual students across the semester from daily participation, test

reviews, and project presentations and were analyzed with ANOVA procedures to see

how the clicker technology impacted student participation at the individual student level.

3.20 Test Data Analysis

The study produced three different sets of achievement data for analysis: the

chapter tests, the group presentation, and the final examination. These class assessments

were analyzed to answer the third research question:

> 3. *How does the use of clickers in the classroom impact student learning of course content?*

These scores were subjected to ANOVA procedures to determine if using the

clicker technology had a significant impact on the overall course assessments.

3.21 Conclusion

The frame work for this study was developed using the knowledge gained from the semester pilot study and this researchers experience with the clicker technology at both the university and high school level.   Chapter four will display the results of the study and show a comparison of the Traditional Class and Clicker Class during the course of the semester.

Chapter 4

Results

The purpose of this research was to evaluate the impact of clicker technology in the classroom; specifically how clickers affect the extent and quality of student participation and learning in a high school business class. The research questions explored in this study were:

1. *How does the use of clickers impact the level of student participation in classroom discussions?*

2. *How does the use of clickers impact the quality of student participation in classroom discussions?*

3. *How does the use of clickers in the classroom impact student learning of course content?*

The results of this section are based on the date obtained from systematic classroom observations and student performance on class assessments. Data were collected over a semester (90 class periods) from two high school Business Law classes, one class in which the clickers were used (referred to as the Clicker Class) and the second a class in which clickers were not used (referred to as the Traditional Class). Class content and presentation was the same in both classes. All students were subjected to the same discussion topics and class assessments.

4.1 Data Analysis Procedures

This researcher used data collected over a semester time frame from a population of 39 high school students at the junior and senior grade level, with an age range from 16 to 18 years old. The research questions were examined using ANOVA procedures. ANOVA assumes normal distribution and equal variances in the Clicker Class and

Traditional Class data, assumptions that were tested and found within reasonable limits. Statistically significant differences between the Clicker Class and Traditional Class data on the outcome measures of participation and achievement were determined based on an alpha level of 0.05.

4.2 Class Participation

Figure 4.1 shows a breakdown of all the Class Participation, both Passive Participation (PP) and Active Participation (AP), scored and recorded during the semester. The range for the Traditional Class was 62 to 140; the lowest amount of responses (scored 1-5) from a student in the Traditional Class was 62 and the highest number of responses from a student in the Traditional Class was 140, with a median score of 100. The range in the Clicker Class was 80 to 150; the lowest amount of responses (scored 1-5) from a student in the Clicker Class was 80 and the highest number of responses from a student in the Clicker Class was 150, with a median score of 120. Comparison of the two ranges shows that the Clicker Class students were more active on both the low (62–80) and high (140–150) ends when it came to the frequency of responses scored during class.
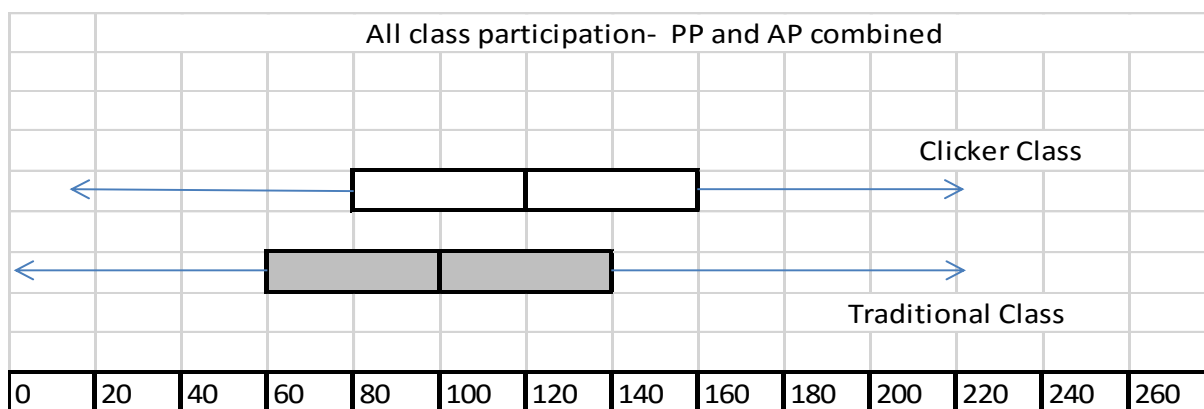
Figure 4.1. Class participation with passive and active participants combined. Range represents the frequency of responses during the semester in each class.

4.3 Passive Participation

Table 4.1 shows a breakdown of the passive participation for the full semester. A student received a passive score by scoring a "1" on the Class Participation Rating Scale. The total number of students recorded during the first half of the semester was 39, 21 in the Clicker Class and 18 in the Traditional Class. The mean score was 158.76 for the Clicker Class and 91.44 in the Traditional Class. The standard deviation for each class was 5.65 for the Clicker Class and 38.50 for the Traditional Class.

Table 4.1
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Passive Participation in Full Semester

Class	*n*	*M*	*SD*	*SE*
Clicker	21	158.76	5.65	1.23
Traditional	18	91.44	38.50	9.07
Total	39	127.69	42.84	6.86

Table 4.2 shows the results of an ANOVA based on the semester of Passive Participation scores. The ANOVA table determines if there is a statistical difference between the two classes. The results of Table 4.2 show that there is a significant difference between the two classes during the semester, with a Sig score of .000.

Table 4.2
Results of ANOVA on Passive Participation for Full Semester

	SS	*df*	*MS*	*F*	Sig.
Between groups	43,922.05	1	43,922.05	62.89	.000
Within groups	25,838.25	37	698.33		
Total	69,760.31	38			

Table 4.3 shows a breakdown of the passive participation for the first half of the semester. A student received a passive score by scoring a "1" on the Class Participation Rating Scale. The total number of students recorded during the first half of the semester was 39, 21 in the Clicker Class and 18 in the Traditional Class. The Mean score was 80.38 for the Clicker Class and 42.611 in the Traditional Class. The standard deviation for each class was 3.15 for the Clicker Class and 18.75 for the Traditional Class.

Table 4.3
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Passive Participation in First Half of Semester

Class	n	M	SD	SE
Clicker	21	80.38	3.15	.68
Traditional	18	42.61	18.75	4.42
Total	39	62.94	22.94	3.67

Table 4.4 shows the results of an ANOVA based on the first half of the semester, 45 days, Passive Participation scores. The ANOVA table determines if there is a statistical difference between the two classes. The results of Table 2 show that there is a significant difference between the classes for the first half of the semester, with a Sig score of .00

Table 4.4
Results of ANOVA on Passive Participation for First Half of Semester

	SS	df	MS	F	Sig.
Between Groups	13826.66	1	13826.66	82.79	.00
Within Groups	6179.23	37	167.00		
Total	20005.89	38			

Table 4.5 shows a breakdown of the passive participation for the second half of the semester. A student received a passive score by scoring a "1" on the Class Participation Rating Scale. The total number of students recorded during the first half of

the semester was 39, 21 in the Clicker Class and 18 in the Traditional Class. The Mean

score was 78.38 for the Clicker Class and 48.833 in the Traditional Class. The standard

deviation for each class was 5.12 for the Clicker Class and 19.91 for the Traditional

Class.

Table 4.5
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Passive
Participation in Second Half of Semester

Class	*n*	*M*	*SD*	*SE*
Clicker	21	78.38	5.12	1.11
Traditional	18	48.83	19.91	4.69
Total	39	64.74	20.34	3.25

Table 4.6 shows the results of an ANOVA based on the second half of the

semester, 45 days, Passive Participation scores. The ANOVA table determines if there is

a statistical difference between the two classes. The results of Table 4.6 show that there

is a significant difference between the two classes for the first half of the semester, with a

Sig score of .00.

Table 4.6
Results of ANOVA on Passive Participation for Second Half of Semester

	SS	*df*	*MS*	*F*	*Sig.*
Between Groups	8461.98	1	8461.98	43.08	.00
Within Groups	7267.45	37	196.41		
Total	15729.43	38			

4.4 Passive Participation Results On Introduction Questions

Introduction questions were used to begin the most of the classes during the

semester. The questions were designed to get students thinking and discussing the daily

lesson. These questions were scored as Passive Participation questions; scored as a 1 on

the grading scale. A one was earned by the student raising their hand, giving a one word answer, nodding their head, or entering an answer on their response unit after the question was asked by the instructor.

In the Traditional Class the average Passive Participation score for the semester was .25, which meant that 25% of the time students in the Traditional Class willing responded to the introduction question. In the Clicker Class the average Passive Participation score for the semester was 1, meaning that students responded 100% of the time to the introduction questions. This large discrepancy between the two classes will be explained in Chapter 5, but it is obvious that the clicker technology played a role in getting students to respond.

4.5 Active Participation Semester Results

The data in section 4.5 reflects the Active Participation scores. Active Participation was determined by the number of times a student scored a 2, 3, 4, or 5 on the Class Participation Rating Scale. A score of a 2 represented that the student responded to a question directed by the instructor with a short one word answer, a score of a 3 represented that the student responded to a question directed by the instructor with a more elaborate answer, a score of 4 meant that the student voluntarily offered a response or answer without being asked directly by the instructor, and a score of 5 was earned when a student voluntarily responded to a statement made by another student.

The Active Participation scoring range was 2-5. The following shows the sample answers that would be graded following the Class Participation Rating Scale:

Score- 2 Student responded to the instructor's question addressed specifically to them   with a short verbal answer *Example: Instructor- "Billy, what type of law does the word Tort refer to?". Billy- "Civil".*

Score- 3 Student responded to the instructor's question with an elaborate answer or explanation (more than one or two words from recall). *Example: Instructor- "Mary, what are some of the results of civil lawsuit abuse?". Mary- "Civil lawsuit abuse can result in higher insurance prices, or may cause smaller companies to   go out of business."*

Score- 4 Student volunteers a comment or elaborates in response to the instructor's comments or gives feedback to a question not directed at the student. *Example- Billy is asked by the instructor to explain the steps in a civil trial. Billy cannot identify all the steps so Mary raises her hand and after being called on and gives the correct answer.* Mary receives a score of "4".

Score- 5 Student volunteers a comment or elaborates in response to an initial comment made by another student. *Example- Mary answers the instructor's   question concerning employment discrimination laws. Billy raises his hand on his own and is called on by the instructor. Billy disagrees with Mary's answer and makes a statement of his own explaining why and offers his own thoughts   on employment discrimination.* Billy receives a score of "5".

Table 4.7 shows a breakdown of the Active Participation for the full semester. A student received an active score by scoring a 2, 3, 4, or 5 on the Class Participation Rating Scale. The total number of students recorded during the semester was 39, 21 in the Clicker Class and 18 in the Traditional Class. The mean score was 90.04 for the Clicker Class and 97.16 in the Traditional Class. The standard deviation for each class was 54.19 for the Clicker Class and 66.79 for the Traditional Class.

Table 4.7
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Active Participation in Semester

Class	n	M	SD	SE
Clicker	21	90.04	54.19	11.82
Traditional	18	97.16	66.79	15.74
Total	39	93.33	59.62	9.54

Table 4.8 shows the results of an ANOVA based on the semester of Active

Participation scores. The ANOVA table determines if there is a statistical

difference between the two classes. The results of Table 4.8 show that there is no

significant difference between the two classes during the semester, with a Sig score of

.71.

Table 4.8
Results of ANOVA on Active Participation for the Semester

	SS	*df*	*MS*	*F*	*Sig.*
Between Groups	491.21	1	491.214	.13	.71
Within Groups	134595.45	37	3637.71		
Total	135086.66	38			

Table 4.9 shows a breakdown of the Active Participation for first half, 45 days, of

the semester. A student received an active score by scoring a 2, 3, 4, or 5 on the Class

Participation Rating Scale. The total number of students recorded during the first half of

the semester was 39, 21 in the Clicker Class and 18 in the Traditional Class. The mean

score was 43.38 for the Clicker Class and 46.55   in the Traditional Class. The standard

deviation for each class was 29.23 for the Clicker Class and 33.07 for the Traditional

Class.

Table 4.9
*Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Active
Participation in First Half of Semester*

Class	*n*	*M*	*SD*	*SE*
Clicker	21	43.38	29.23	6.38
Traditional	18	46.55	33.07	7.79
Total	39	44.84	30.68	4.91

Table 4.10 shows the results of an ANOVA based on the first half, 45 days, of the

semester Active Participation scores. The ANOVA table determines if there is a

statistical difference between the two classes. The results of Table 4.11 show that there is

no significant difference between the classes during the semester, with a Sig score of .75.

Table 4.10
Results of ANOVA on Active Participation for First Half of Semester

	SS	df	MS	F	Sig.
Between Groups	97.680	1	97.68	.101	.75
Within Groups	35689.39	37	964.57		
Total	35787.07	38			

Table 4.11 shows a breakdown of the Active Participation for the second half, 45

days, of the semester. A student received an active score by scoring a 2, 3, 4, or 5 on the

Class Participation Rating Scale. The total number of students recorded during the second

half of the semester was 39, 21 in the Clicker Class and 18 in the Traditional Class. The

mean score was 46.66 for the Clicker Class and 50.61 in the Traditional Class. The

standard deviation for each class was 25.58 for the Clicker Class and 34.09 for the

Traditional Class.

Table 4.11
*Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Active
Participation in Second Half of Semester*

Class	n	M	SD	SE
Clicker	21	46.66	25.58	5.58
Traditional	18	50.61	34.09	8.03
Total	39	48.48	29.47	4.71

Table 4.12 shows the results of an ANOVA based on the second half, 45 days, of

the semester Active Participation scores. The ANOVA table determines if there is a

statistical difference between the two classes. The results of Table 4.12 show that there is

no significant difference between the classes during the semester, with a Sig score of .68.

Table 4.12
Results of ANOVA on Active Participation for Second Half of Semester

	SS	*df*	*MS*	*F*	*Sig.*
Between Groups	150.799	1	150.79	.107	.68
Within Groups	32858.94	37	888.08		
Total	33009.74	38			

4.6 Student Presentation Participation

Table 4.13 was collected during the last four days of the class when Student

Presentations were taking place. During this time students had the chance to critique

other students as each group presented their final project. The data in Table 4.13

represents the total number of AP scores, 2-5, recorded during the presentation period.

Table 4.13
Total Active Participation Scores during student presentations

Class	*Recorded Responses*	*Average AP Score*
Clicker	11	2.18
Traditional	9	2.11
Total	20	

The results in Table 4.13 show that during the four day period of student

presentations there were 11 responses that scored a 2, 3, 4 or 5 in the Traditional Class

and 9 responses in the Clicker Class. Of the 11 responses in the Traditional Class the

breakdown was two scores of a 3, nine scores of a 2, and zero scores of 4 or 5. In the

Clicker Class the breakdown of the 9 responses was one 3, and eight scores of a 2, and zero scores of 4 or 5. The average recorded score was 2.18 in the Traditional Class and 2.11 in the Clicker Class.

4.7 Class Participation Comparison

Figure 4.2 breaks down and compares the two types of class participation, Passive Participation and Active Participation in both classes over the course of the semester. The gray blocks compare and show the range of Passive Participation scores for both the Traditional Class and the Clicker Class. The Traditional Class range for Passive Participation scores was 60 to 120. These numbers represent the number of times a student scored a "1" on the Class Participation Rating System. The Clicker Class range for Passive Participation scores was 146 to 170. This also represents the number of times a student scored a "1" on the Class Participation Rating System.

The white blocks compare and show the range of Active Participation scores for both the Traditional Class and the Clicker Class. The Traditional Class range for Active Participation scores was 43 to 157. These numbers represent the number of times a student scored a 2, 3, 4, or 5 on the Class Participation Rating System. The Clicker Class range for Active Participation scores was 19 to 122. This also represents the number of times a student scores a 2, 3, 4, or 5 on the Class Participation Rating System.
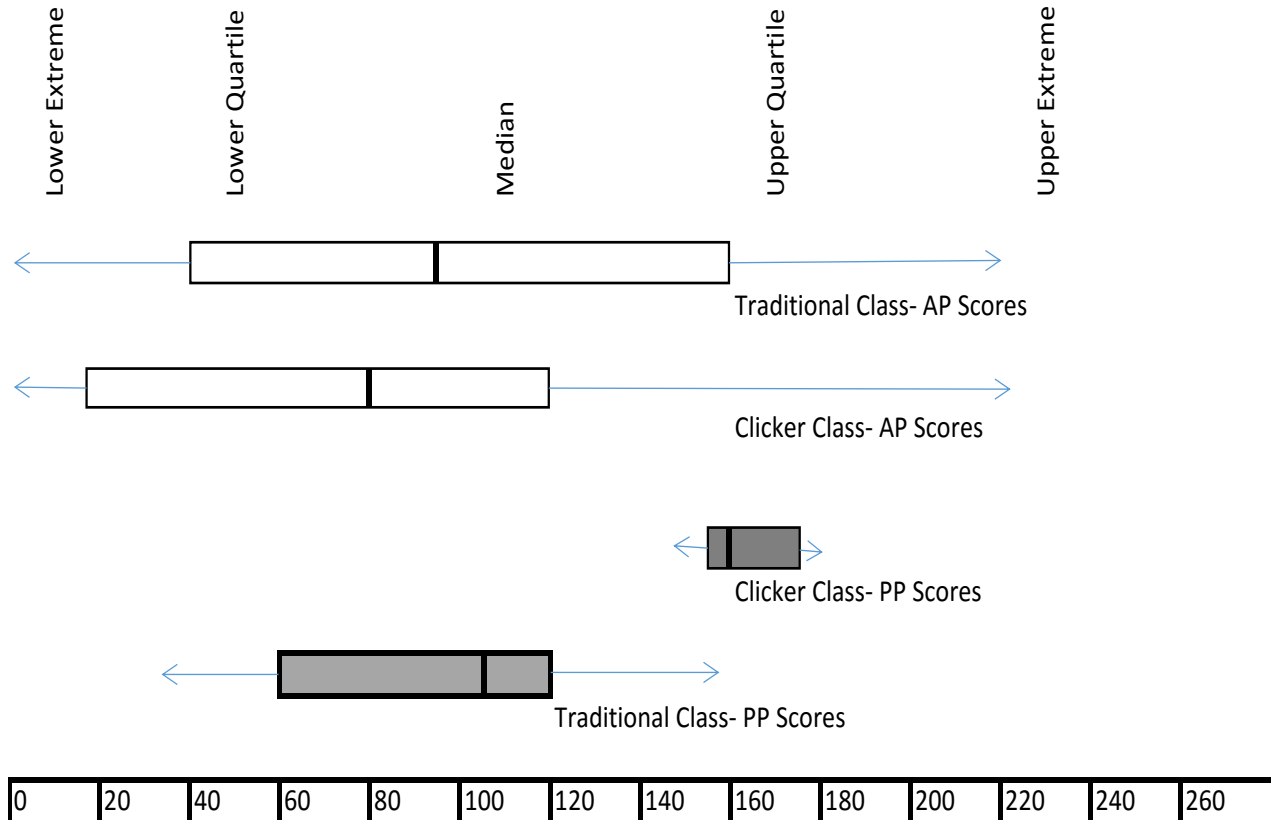
Figure 4.2. Class participation, passive and active, for each class. White bars represent Active Participation (AP) scores and gray bars Passive Participation (PP) scores.

The results of Figure 4.2 show how active students in both classes were during the semester. The comparison of the Passive Participation scores, gray blocks, show that the students in the Clicker Class were in the upper quartile range compared to the students in the Traditional Class who scored below the lower quartile to median range. The comparison of the Active Participation scores, white blocks, show that the students in the Traditional Class were above the median range when compared to the students in the Clicker Class.

Figure 4.2 reveals higher results for all four quartiles of the Clicker Class compared to the four quartiles of the Traditional Class. Disaggregating the data into Passive Participation and Active Participation reveals that the results from Figure 4.2

may be explained by extremely high results in Passive Participation scores in the Clicker Class. One possible explanation for such high Passive Participation results in the Clicker Classroom is that the clicker technology requires participation and students were expected to respond.

Students in the Clicker Class scored higher in the Passive Participation range (scores of 1) because of the technology used during class. The instructor required and monitored the student responses so that every student responded to every question posed to the class. Students in the Traditional Class were ask the same questions, but not necessarily required to respond.

Students in the Traditional Class scored higher in the Active Participation range (2-5). These results show that students in this class had more in-depth discussions and were more active in participating after initial questions were posed to the class.

4.8 Semester Assessment Results

The following sections discuss and display the results for the assessments used in both classes during the semester. Students were assessed from the results of the five section exams, a group presentation, and the final exam. While this study was based on student participation, participation scores were not factored into any assessments and did not play a role in the final semester grade.

4.9 Student Presentations Averages

Students were placed in groups and were required to give a presentation at the end of the semester on various topics covered during the semester. Each group member was

required to contribute to the presentation and was expected to address the class during their presentation to the class. The results of the presentations in each class produced a Traditional Class average score of 86% and the Clicker Class average score of 90%. Groups in both classes were assessed using the same grading scale and criteria. Students had the opportunity to ask questions during each presentation but during this time the clickers were not used in the Clicker Class. Student comments were still recorded and graded but were done so without the use of clickers, both classes operated in the Traditional Class format. While students were encouraged to critique and offer feedback during each presentation, any comments either negative or positive did not affect the presentation grade.

4.10 Section Test Analysis

Tables 4.14 to 4.24 show the breakdown of the five tests given to both classes during the semester. Each class took the same section tests during the semester to assess their knowledge on the subjects covered. Tests were administered on the same day to all students present. Click technology was not used in any capacity during test days.

Table 4.14 shows the class average of the five tests given during the semester for both the Traditional Class and the Click Class. Using the data in Table 4.14 the class average on tests can be calculated to show that the Clicker Class had an overall average of 95% on the five section test, compared to a 92% overall average for the Traditional Class.

Table 4.14
Class average for five section tests.

Class	*Test*	*Class Average*
Traditional	Test 1	97%
Clicker	Test 1	98%
Traditional	Test 2	95%
Clicker	Test 2	94%
Traditional	Test 3	99%
Clicker	Test 3	96%
Traditional	Test 4	84%
Clicker	Test 4	95%
Traditional	Test 5	90%
Clicker	Test 5	92%

When comparing the tests for both classes the largest difference was in Test 4, where the Clicker Class average (96.12%) was 11.16% higher than the Traditional Class average (83.55%). The lowest difference was in Test 2, where the Traditional Class average (94.56%) was 0.34% higher than the Clicker Class average (94.22%).

The test score averages where compared using descriptive statistics and ANOVA analysis. The following data obtained from the analysis found that only one test, Test 4, showed a statistically significant difference between the Clicker Class and Traditional Class, with a Sig score of .019.

Table 4.15
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Test 1
Scores

Class	n	M	SD	SE
Clicker	21	88.48	6.73	1.472
Traditional	18	90.94	8.28	1.95
Total	39	89.62	7.49	1.2

Table 4.16
Results of ANOVA on Test 1 Scores

	SS	df	MS	F	Sig.
Between Groups	59.04	1	59.04	1.05	.31
Within Groups	2074.18	37	56.05		
Total	2133.23	38			

Table 4.17
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Test 2
Scores

Class	n	M	SD	SE
Clicker	21	90.76	4.87	1.06
Traditional	18	90.78	5.01	1.18
Total	39	90.77	4.87	.78

Table 4.18
Results of ANOVA on Test 2 Scores

	SS	df	MS	F	Sig.
Between Groups	.02	1	.00	.00	.99
Within Groups	902.92	37	24.40		
Total	902.92	38			

Table 4.19
Descriptive Statistics (Mean, Standard Deviation, Standard Error) Test 3 Scores

Class	n	M	SD	SE
Clicker	21	92.71	5.51	1.20
Traditional	18	88.50	5.13	1.21
Total	39	90.77	5.68	.91

Table 4.20
Results of ANOVA on Test 3 Scores

	SS	df	MS	F	Sig.
Between Groups	172.13	1	172.13	6.02	.01
Within Groups	1056.78	37	28.56		
Total	1228.92	38			

Table 4.21
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Test 4 Scores

Class	n	M	SD	SE
Clicker	21	91.90	5.02	1.09
Traditional	18	89.22	4.91	1.15
Total	39	90.67	5.09	.816

Table 4.22
Results of ANOVA on Test 4 Scores

	SS	df	MS	F	Sig.
Between Groups	69.74	1	69.74	2.814	.10
Within Groups	916.92	37	24.78		
Total	986.66	38			

Table 4.23
Descriptive Statistics (Mean, Standard Deviation, Standard Error) for Test 5 Scores

Class	*n*	*M*	*SD*	*SE*
Clicker	21	92.29	3.96	.86
Traditional	18	90.89	3.66	.86
Total	39	91.64	3.84	.61

Table 4.24
Results of ANOVA on Test 5 Scores

	SS	*df*	*MS*	*F*	*Sig.*
Between Groups	18.91	1	18.91	1.29	.26
Within Groups	542.06	37	14.65		
Total	560.97	38			

4.11 Final Exam and Overall Class Average Analysis

The Final Exam was a cumulative semester exam given on the last day of class. The average score for the students in the Traditional Class was a 94%, compared to the students in the Clicker Class that scored an average of 90%.

At the end of the semester the final class average was calculated using the grades from the five section tests, the group presentations, and the final exam. The final class average for the Traditional Class was 96% and the Clicker Class final class average was 94%.

4.12 Summary

This chapter began with a breakdown of how the data was going to be analyzed and a description of the demographics of the students participating in the study. The data obtained over the semester time frame were examined using descriptive statistics, including frequencies, means, and standard deviations. The main focus of the study was to determine if there was any significant change in the frequency of student participation with the use of clicker technology, if there was any significant change in the quality of student participation with the use of clicker technology, or if clicker technology had an impact on student performance on class assessments.

The data suggested that there was no statistical significance in the frequency or quality of student participation, or in classroom assessments with the use of the clicker technology. Student participation and success on class assessments did not appear to be affected by the presence, or lack of, clicker technology.

The knowledge gained from this study will assist in contributing to the value that clicker technology contributes to student success in the classroom. Specifically, the data will help other educators gain insight into what value clicker technology may, or may not, bring to a classroom. Chapter 5 will offer an interpretation of the data obtained over the course of the study and provide a conclusion of the findings as they relate to the three research questions that were the foundation of this study. All findings from this study will look to expand the previous knowledge known about clicker technology and the value that has in the classroom. Finally, Chapter 5 will provide suggestions for the most beneficial uses that clicker technology has in the classroom and offer avenues for future research area.

Chapter 5

Summary, Recommendations, and Conclusion

This chapter summarizes the findings that were made during the study, the conclusions that can be drawn from the findings, and offers recommendations to help future studies in this area. The research questions that were used to guide this study were:

When incorporating a classroom response system in a high school classroom:

1. *How, if at all, does the use of clickers in the classroom impact the extent of student participation in classroom discussions?*

2. *How, if at all, does the use of clickers in the classroom impact the quality of   student participation in classroom discussions?*

3. *How, if at all, does the use of clickers in the classroom impact student learning of course content?*

Insight gained from this study may help schools at all levels, secondary through post-secondary, decide if investing in a classroom response system will benefit student learning.   The findings from this study may also assist teachers and administrators in determining if the use of classroom response systems can promote greater student classroom participation and have any impact on student achievement.

Chapter 5 will also present a recommendations to aid others considering doing additional research and studies in the area of classroom response systems as they relate to student participation and overall learning.

5.1 Summary

Classroom participation and being an active learner has been viewed as vital to student learning for years (Frase, et. al 1970). While some suggest that participation in

the classroom is a key to student learning (Hafner, et. al 2004), it can be argued that a "good" student will always be a good student regardless of their level of participation. The purpose of this study was to use quantitative data to determine how a classroom response systems impacted the participation and learning when comparing two high school classrooms. This study was conducted to evaluate the quality of student responses. Specifically, do response systems help promote higher assessment scores?

5.2 Procedures Summary

The researcher used a variety of methods to collect the quantitative data that helped determine the results of this study. These methods included student observation in the classroom, student participation grading, and student grading on class assessments. The populations used for this study were students from two high school classrooms consisting of a total of 39 students between the two classrooms. Permission was given to the researcher prior to the start of the study by the school's administration. The purpose of the study was explained to all the students prior to the start of the study and each student was required to submit a signed parental permission form. Participation in this study was voluntary and all students that did participate were assured that their identity and personal data were protected and all responses were anonymous. All of the students that participated were not identified in any way or manner during the gathering and analyzing of the statistical information.

Student participation was observed and recorded during class using a Likert grading scale to determine the level of student participation. Students received scores ranging from 1-5 depending on their level of class participation. Individual and class

scores for both the Clicker Class and Traditional Class were tallied and analyzed for comparison.

5.3 Findings Related to Research Questions

The following sections will look at the results of the study related to each of the research questions:

Question 1:

How, if at all, does the use of clickers in the classroom impact the extent of student participation in classroom discussions?

How the use of clickers impacted the extent of student participation can be summed up easily after looking at the study results; clickers do have a direct impact on participation. For this study participation was defined as a student engaging in class discussions. Engaging could range from raising a hand, saying "yes" to a question, or elaborating on a given topic.

When comparing the two classes, Traditional and Clicker, the results of three of the tests conducted can be used to sum up the findings and determine if there was a difference in the extent of student participation:

Figure 4.1 displays a breakdown of all the participation, both active (scores of 2-5) and passive (scores of 1), that was recorded during the semester in both classes. In the Traditional Class the range of recorded participation scores was 62 to 140, with a median score of 100. In the Clicker Class the range of recorded scores was 80 to 150, with a median score of 120. Students in the Clicker Class outscored the students in the Traditional Class on both the low and high end of responses.

It is important to keep in mind that students in the Clicker Class were required to respond to certain questions during class. The clicker technology would display each student's pad number so the instructor knew exactly when each student did or didn't respond. This could easily attribute to the high number of passive scores recorded during the semester in the clicker class, as they were expected to respond.

Table 4.1 shows the passive participation for the semester in both the Traditional Class and Clicker Class. Passive participation scores were identified as a "1" on the Class Participation Rating System. A score of a "1" was the lowest participation score a student could receive and could be earned by raising their hand, responding to a question with a one word response, or responding on their clicker pad.

The mean score for students in the Traditional Class was 91.44, compared to the mean score in the Clicker Class of 158.74. Students in the Clicker Class clearly outscored the students in the Traditional Class which was expected as the study was conducted. Students in the Clicker Class had many questions posed to them during the semester so that they could easily respond with their clicker. As stated earlier, students in the Clicker Class were required to respond to certain questions before the instructor moved on or closed the question.

The last statistic that clearly showed the impact that clickers had on class participation was obtained from observing students responding to the introduction questions. Classes frequently began with a question or topic to get students thinking about the daily lesson. These questions usually required a yes/no or a few specific options as answers.

When these types of questions were used at the beginning of each class the recorded results were 25% for the Traditional Class and 100% for the Clicker Class. Simply put, the students in the Traditional Class willingly responded 25% of the time to the introduction question. When the question was posed to the Traditional Class students they were ask to raise their hand with their response, but while encourage to respond, were not required to respond. When comparing the responses of the Clicker Class to introduction questions these students responded 100% of the time. Once again it is important to note that the clicker technology displayed each individual pad number so the instructor knew exactly when all the students had entered their answer. The instructor would encourage responses, and the use of the clicker would all but require the students to respond to all the introduction questions.

When answering the first research question used in this study it is the researcher's opinion that clickers do impact the extent of student participation. The statistics in this section show that the presence of a classroom response system directly impacted the extent of participation of students in the clicker classroom when compared to the traditional classroom.

Question 2:

How, if at all, does the use of clickers in the classroom impact the quality of student participation in classroom discussions?

Determining the quality of student participation was the most difficulty of the three questions used for this study to address. The actual quality of a student's response in class is open to many interpretations and can be viewed in variety of opinions. To help set a guideline to rate student responses the Classroom Participation Rating System was

developed. The rating system described in Chapter 3, section 3.13, details the rating

scale that was used to score a response made in either class. A response receiving a score

of a 1 was lowest score, and considered passive participation, while a response receiving

a score of 2-5 was considered active participation because it required a more in-depth

reply.

The data used to address research question #2 focused on results pertaining to

responses scoring in the active participation range, 2 through 5. For this study active

participation was viewed as more critical thinking from the student. When reviewing the

data the Clicker Class did not appear to have more quality discussions when compared to

the Traditional Class.

Table 4.7 showed a breakdown of active participation scores recorded in both

classes during the semester. Looking at these results the Traditional Class students had a

higher mean score, 97.16, compared to the Clicker Class students with a mean score of

90.04. These numbers show that students in the Traditional Class were actively

participating and interacting more than Clicker Class students. If a student in a more

active learning environment is viewed to be more engaged in the learning process (Angel,

2008) then one must ask if clickers are promoting discussions. If clickers are also being

used to build student confidence then the Clicker Class students would have higher score

on the active participation scale which was not the case.

Similar results were also found when looking at Figure 4.2, Classroom

Participation Comparison. The range of students scoring a 2-5 in the Traditional Class

was 43 to 157, this meant that the student in the Traditional Class with the lowest active

participation score was 43, and student with the highest active participation score was

157. When compared to the Clicker Class the lowest student response score was 19 and the highest 122. The use of this set of data was to determine how active, engaged, the students were after the initial questions were used at the beginning of class. These numbers show that the use of clickers did not necessarily stimulate more student interaction between the teacher and student, or amongst the students.

When answering the second research question used in this study it is the researcher's opinion that clickers do not have an impact on the quality of student participation. The researcher recognizes the difficulty in determining the quality of any classroom discussion and it is a very subjective area. However, if the use of clickers is to give a student the confidence to engage more if they know they are correct there was no significant sign of students engaging more in the Clicker Class just because they answered a previously posed question correctly.

Question 3:

How, if at all, does the use of clickers in the classroom impact student learning of course content?

To address this question the class assessments were evaluated to determine how well the students did during the semester. Student assessments took place in four forms: 1- five section tests given periodically during the semester, 2- one group presentation presented at the end of the semester, 3- the final examination administered on the last day of class, and 4- the overall class average which took into account all the assessments.

The overall class averages for the sections tests were 95% for the Clicker Class, and 92% for the Traditional Class. When breaking down the scores for both classes there was only a difference of 1% - 3% on four of the five section tests. Section Test 4 had the

largest class average difference between the two classes, where the Clicker Class average was 96.12% and the Traditional Class average was 83.55%, for a difference of 11.16%. When compared using descriptive statistics and ANOVA analysis this was the only test that showed a statistically significant difference between the Clicker Class and Traditional Class, with a Sig score of .019.

The Final Exam was a cumulative semester exam given on the last day of class. The average score for the students in the Traditional Class was a 94%, compared to the students in the Clicker Class that scored an average of 90%. When compared there was no significant difference between these two scores.

At the end of the semester the final class averages were calculated using the grades from the five section tests, the group presentations, and the final exam. The final class average for the Traditional Class was 96% and the Clicker Class final class average was 94%. When looking at the overall class average there was once again no significant difference between the two classes.

When attempting to answer the third research question used to guide this study it is the researcher's opinion that the use of clickers did not impact student learning on assessments. The use of clickers may have led to more class participation by students in the Clicker Class, but there was nothing to suggest that the presence of a classroom response system aided in higher scores on assessments at any point during the semester.

5.4 Implications

While this researcher believes this study had a rational design there were areas that could have been altered. The implications from this study cover three areas- sample

size, assessing the quality of discussions, the use of clicker technology for passive participation questions, and class set up.

The sample size for this study was 39, which could be considered on the small size. While conducting a similar study with a larger sample size could provide different results that gauge the value of classroom participation systems it would also be difficult to track and score student participation, addressed in the next paragraph. This researcher was limited in sample size due to class scheduling and student enrollment.

Assessing the quality of classroom discussions was another area that revealed some difficulty during the study. The development of the Classroom Participation Rating System was a valuable tool to use in an attempt to score comments made by the students during class, but could still provide inconsistent results. Developing a standard by which student comments are assessed is a subjective area and could be misinterpret between assessors.

The premise of clicker technology is that all students will participate because they are being monitored by the instructor. For this study students in the Clicker Class were required to respond to questions posed to the class because the monitor displayed which students did, or didn't, enter an answer. The instructor would not close a question until all student responses were recorded. This type of monitoring had a direct effect on the passive participation scores in the Clicker Class.

Class set up was another area that was reconsidered at the conclusion of the study. The Traditional Class and Clicker Class were random assigned prior to the start of the semester. These two classes remained the same, Traditional and Clicker, for the entire semester. One could argue that a more accurate comparison of the two classes through

their assessments and discussions could have been made if all students were exposed to the clicker technology. Switching class designs at the midpoint of the semester may have led to different findings.

5.5 Recommendations for Future Studies

The conclusion of this study will show that there is little doubt that when used correctly a classroom response system can increase the level of student participation. A future study could include the question, "How does the lack of a classroom response system affect a student's participation after using one?" While monitoring a group of students' classroom participation using clickers a researcher could track what happens to that level of participation once the clicker is taken away from the student.

Attempting to assess the quality of student participation that clicker technology has is the challenge for future studies. Developing an accurate assessment tool to score student interactions that take place in the classroom is not an easy task, but if one could be created it would help in similar studies. Creating, or enhancing, a scoring system comparable to the Class Participation Rating System used in this study would be beneficial and help researchers create a level playing field when scoring students.

5.6 Study Conclusions

This study evaluated how a classroom response system could impact student participation, improve the quality of student participation, and affect the overall assessment performance of students. When analyzing the data derived from this study several conclusions were discovered based on the information obtained.

The first conclusion is that classroom participation can directly impact a student's performance. An active learner is just that, active by definition and involved in the learning process. A student taking ownership of how they spend their time in the classroom has the potential to lead to higher assessment scores. While the study results may not have shown a significant difference in overall grades between the two classes, there is no reason to believe that the grades of the students that did participate more during the semester actually suffered.

The second conclusion is that the use of clickers in the classroom do promote student participation. Classroom response systems are designed so that students have no choice but to participate when polled by their instructor. The combination of a student having an assigned clicker for class and the instructor's ability to see who has, or hasn't, responded to a question is a powerful setup. Critics may say that pushing a button is not "participating", but it is a start and does require the student's attention which is a good thing, and if nothing else a step in the right direction to get them engaged.

The third conclusion is that assessing the value that a classroom response system adds to the quality of student participation is difficult. So many factors play a role in if and when a student is willing to participate in class- personality, intellectual ability, class size, comfort level of the material, and motivation to name a few. To properly assess, or score, the quality of a student's remarks is a daunting task even with some type grading tool. Any student that is willing to raise their hand to add to a class discussion should be viewed as contributing to the class. Not all students view the same question or topic in the same manner, and with different experience come different views. Encouragement

may be the best classroom participation tool a teacher can use to get "quality" responses from their students.

The final conclusion that was derived as a result of this study is how a classroom response system should be viewed- learning tool or classroom toy? Anyone that is curious about incorporating the use of clickers in their classroom should do so as they can add value to the learning experience. Clickers, or any polling device, have the potential to add excitement to a lesson and break up daily class routines. Getting 100% of your students to raise their hand and to vote for their choice is a difficult task for even the most seasoned teacher. Likewise, asking students at the end of class if "there are any questions" may rarely inspire a student to identify themselves. Which is why using clickers may be the best way for teacher to assess student retention at any point during class.

So what does it all mean? Clickers have the ability to accomplish many things when used as a supplemental tool during a lesson and do have a place in any classroom. In the end though it is this researcher's opinion that one thing seems certain, there is not a technological device that exists that will ever replace what a dedicated teacher can do to motivate a student.

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