Clicking Toward an Engaged Algebra I Classroom

A Capstone Project Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Teaching: Mathematics

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## Abstract

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## Acknowledgements

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## **Chapter One**

## Introduction

Jimmy is sitting in a classroom and his palms begin to sweat. Jimmy looks up at the board and notices the math problem seemingly glaring him straight in the eyes. After a few minutes, he has an answer circled on the paper on his desk. Jimmy begins to ask himself, "Is my answer correct?" Mr. Jastrom, Jimmy's math teacher, looks ready to call on someone in the class for the answer, and Jimmy hopes that it is not him for fear of being wrong in front of his friends, his classmates.

Many people have been in a similar situation or have seen that scenario play out in a classroom. The same hands always go up to answer questions. What about the other students? How can teachers help to engage all students in the mathematics classroom?

With technology showing society that the sky is the limit, there must be a way to utilize modern elements to make sure the scenario above doesn't continue to happen in most mathematics classrooms in America. Teachers know class participation can always be improved. Their hope is that when they ask a question, all students' hands go up willing to answer. However, it seems like the same students answer questions every day. Why does this occur? Are students scared to answer incorrectly? Do students not know the answer or not want to answer? Would there be more participation if students could answer anonymously? Welcome to the world of personal response systems. With personal response systems, students can answer freely without the fear of giving the wrong answer in front of their classmates. This project will determine whether the use of a personal response system will increase student participation and engagement in a mathematics class.

#### **Motivation for the Project**

I am very interested in the personal response system or "clickers" as my school recently bought a set to go along with our SMART Boards<sup>TM</sup>. My classroom has always had a handful of students willing to answer questions in class, and the rest of the class has low participation during a typical lecture. In my opinion, the use of a personal response system can improve class discussion, participation, and enhance student learning immediately.

I was able to witness this first hand at the college level. In the 2010 summer semester, a professor used a personal response system in one of my graduate courses, Geometry for Secondary School Teachers. I was immediately taken by this. The same students didn't answer every question; students' names were withheld on correct/incorrect responses; and it generated a vast amount of discussion. My experience in the classroom was such a positive experience because of the constant engagement in the lecture and class discussions generated. It was also appealing that the professor was able to adjust his lesson plan immediately if the class needed another example or if the class was ready to move on. I felt strongly that the personal response system benefited my learning, and I would like to bring that positive experience into my classroom.

#### **Background on the Problem**

Technology use in the everyday classroom is becoming more of a reality than it was in the past. According to the market research firm Future Source Consulting, more than 300,000 interactive whiteboards were sold in the United States and 750,000 globally in 2009, an increase of 34% over 2008 (Eisele-Dyrli, 2010). I teach at a small Midwestern school with approximately 120 students in grades 7-12. By next year, all classrooms will be equipped with a SMART Board<sup>TM</sup>. In conjunction with my SMART Board<sup>TM</sup>, I have access to the personal response system the school system recently purchased. With so many technological resources to use in the classroom, the typical classroom may be going extinct while more and more technology and interactive materials are becoming readily available.

I have noticed a trend that not only affects small town North Dakota, but classrooms throughout the nation. This problem affects all instructors across the curriculum. Teachers all have students who sit back, remain quiet, and wait for the bell to ring. I feel teachers all strive for student engagement and interaction. What would society be like if students and teachers didn't discuss problems with each other? Nothing would ever get accomplished! What happens when high school students go to college and are assigned a group project, will they know how to collaborate and work together? Fact is, once students reach the "real world" or go to college, they need to interact with each other on a daily basis. That starts in today's classrooms! Teachers need to prepare students for the future. As a teacher myself, student interaction, participation, and discussion on a daily basis would make my job even easier, and it would make teaching even more fun! An engaged class is a class where students care about learning and don't want the bell to ring the second they sit down. The students enjoy the class and, as a teacher, you enjoy seeing and working with them as well.

Low student interaction and participation began to arise because many teaching styles became stagnant. Think of all the ways society has changed. Almost everyone has a cell phone, Internet access, and other technologies. How many people know a teacher who teaches the same way as 20 years ago? They stand in front of the white board (or chalk board) and lecture the entire hour, everyday, for 180 school days with no discussion amongst students or studentteacher interaction.

Student interaction is significant because it affects everyone. If teachers don't teach students how to solve problems, work together, and discuss issues, society might spiral downward in a hurry. I feel it is important to research this problem! Why? Not only will this research show my students what it is like to interact with each other, discuss problems, work together, and become more engaged in the classroom, but they will carry these life skills with them for the

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rest of their lives. I care, as an educator, enough to find out if the personal response system will benefit my students' learning as it did mine at Minot State University.

## **Statement of the Problem**

After five full years of teaching, I have begun to notice a trend with student interaction in the math classroom. Seemingly, all students want to participate but only a couple of hands go up, and it is always the same hands, to voluntarily explain their answers or answer the teacher's questions. Are students scared of answering for fear of being incorrect?

As a high school student, undergraduate, and graduate student, I have always believed that student interaction and discussion have a direct relationship to learning. From my experience as a student, gaining immediate feedback during a lecture affects both the instructor and students in a positive way.

## **Statement of Purpose**

The purpose of my action research is to determine whether use of a personal response system, or PRS, increases student participation and engagement in a high school mathematics Algebra I class. Further, I will describe student reactions to the use of personal response systems and determine whether students perceive the personal response system to be a beneficial mathematics learning tool.

#### **Research Questions/Hypotheses**

Will use of the personal response system in my Algebra I class improve student engagement? What will the positive and negative response from the students be? How will students respond to using the personal response system in Algebra I? Will students find the use of the personal response system to be a positive mathematics learning tool?

I hypothesize that the students will enjoy using the personal response system and feel the entire process will be a positive experience all while feeling very engaged with the lecture. Hopefully, they will be more engaged than they are now.

## Summary

I have been in the classroom as a teacher and as a student. Student discussion and interaction have always been areas I wanted to improve in my classroom. After using the personal response system firsthand, I know the positive affect it had on my learning, as well as the entire class. My personal background as a student and educator has led me to focus my research on the personal response system in the mathematics classroom and answer my research questions stated above.

#### **Chapter Two**

#### **Review of Literature**

Traditional classrooms are becoming a thing of the past. The use of technology is becoming an everyday essential to education. As an educator, I have noticed that student participation, in the mathematics classroom, does not involve every student. Can the use of technology improve student participation and engagement? The purpose of my action research project is to determine whether use of a personal response system, or PRS, increases student participation and engagement in a high school mathematics Algebra I class. Further, I will describe student reactions to the use of personal response systems and determine whether students perceive the personal response system to be a beneficial mathematics learning tool. The use of the PRS, background of the PRS, and case studies involving the PRS are analyzed and summarized in the review of literature.

### The Personal Response System

The personal response system (PRS) is a technological tool to use in the classroom. The idea behind the system is that each student is equipped with a hand-held electronic transmitter, and the entire class is able to participate in lecture and other classroom activities. The teacher may pose questions which students consider and answer via the transmitters, providing interaction and an activity for the students and feedback for the teacher (d'Inverno, Davis, & White,

2003). The system is often called "clickers" due to the handheld remotes resembling television remotes.

A common model from SMART Technologies (2010) is shown in Figure 1. According to SmartTech (2010), this brand is ideal for most K-12 classrooms. SMART Response PE includes wireless remotes and powerful assessment software that can deliver formative and summative assessments using a variety of question types.



Figure 1. SMART Response PE Clicker from SMART Technologies.

Why is there need to increase student participation? Utilizing breaks during lectures allows students to refocus. It is common knowledge that most people cannot concentrate for extended periods beyond 20 minutes so a break in the lectures are often helpful (d'Inverno et al., 2003). Students rarely ask questions in class, though many clearly do not understand much of the material. The instructors are finding it difficult to identify where students are having problems (Hall, Thomas, Collier, & Hilgers, 2005).

#### **Checking Students' Understanding**

The PRS system can also be used to evaluate how well a teacher is presenting his or her material. For example, if a majority of the class gets an answer incorrect, the material needs to be presented again or in an all-outdifferent approach. On the other hand, if the entire class gets an answer correct, the next set of practice problems and new material may be covered immediately. Teachers can immediately decide whether there is a need for further instruction or supplementary materials (Zhu, 2007). Lesson plans can be changed instantaneously. If students need more instruction than an instructor has planned, additional problems can be created. Likewise, if more questions are prepared than the student needs to master the material, the instructor may proceed with new material.

Using the PRS allows the instructor to permit students' to respond anonymously. There may not be sensitive topics or controversial issues in the 9

mathematics classroom, but students may be more willing to participate knowing the entire class will not see their answers. When students recognize their own opinions or answers, they will actively feel like they are part of the lecture. As a result, students will be more engaged in and responsible for their own learning (Zhu, 2007).

## **Benefits and Drawbacks**

While researching benefits and drawbacks from instructors and students after clicker use numerous benefits and drawbacks were evident. Some examples of the benefits include the following: lecture became more fun and class became more interesting (Zhu, 2007). Examples of drawbacks included technical difficulties and the flow of the lecture seemed to be ruined (Zhu, 2007). In the mathematics classroom, the clickers were used to deliver multiple choice questions which led to improved concentration during lectures and greater enjoyment (d'Inverno et al., 2003).

Some people just do not like change. Most people believe anytime you deal with technology, there is a chance something will go wrong or something will not work properly. Wiess (2009) mentioned that technology, too often and too readily, can create a communication gap between instructors and their students. Some negative reactions in the past have included: "stop messing around with technology and get back to good basic teaching" (d'Inverno et al., 2003, p. 166).

According to SmartTech (2010), the cost of the SMART Response LE System with receiver and 18 remotes is \$1239 with an additional \$2700 to \$4000 for an interactive whiteboard with projector. Zhu (2007) also referenced cost as a big downfall of using the clickers. At a big college, there may be courses where students are required to purchase their own hand-held remote.

Analyzing different cases showed that about 88% of students either "frequently" or "always" enjoyed using the clickers in the classroom (Caldwell, 2007; d'Inverno et al., 2003). Popelka (2010) stated that 100% of her students thought that the PRS helped them understand mathematics better. Clickers seemed to be appealing; most students like the clickers.

At the University of Missouri-Rolla, during the fall of 2004, Hall et al. (2005) integrated the student response system (SRS), which is just another name for the same system as the PRS, into a large chemistry lecture course. The following were some of the survey results after implementation:

- 1) The SRS lead to more efficient use of class time and materials
  - a. They allow more time because you don't have to pass out quizzes.
  - b. They're a lot more efficient than paper and pencil.
- 2) The SRS increased student engagement
  - a. They help to engage the students and keep us awake.

- b. The clickers helped me pay attention and get involved in problem solving.
- There were technical issues that hampered the effectiveness of the SRS
  - a. Better color contrast on the screen. More unobstructed receivers. Battery checks.
  - b. The sensor to inquire the infrared signal is weak so that students have to wait too long to answer using clickers.
- 4) The SRS facilitate group work
  - a. The clickers allowed for group discussion
  - b. Through the use of the clickers you interact more. (Hall et al.,
    - p. 5)

When results are being collected anonymously, students are more apt to participate and listen. If students participate and listen at a higher level, they are going to have a greater retention and comprehension. Webking and Valenzuela (2006) analyzed their case study and found the use of the PRS can help students to engage in the process of analysis and to understand what they are doing as they do so. The analysis of texts involves reading critically to understand and embrace the statements and arguments found there, considering those statements and arguments together to discover apparent contradictions or things that do not seem to be clear when put together, and learning from those apparent contradictions or difficulties to develop a conceptual understanding of the problem at hand (Webking & Valenzula).

"Rather than the technology being the mode of the education, it was rather the means by which the education was delivered, albeit a fun and novel means, but it delivered" (Kift, 2006, p. 93). It is apparent the PRS system has the potential to provide a technological advantage without the compromise of losing educational fortitude.

An advantage to using a PRS is it makes each student continually active in working with the material and the instructor (Webking & Valenzuela, 2006). It is sometimes suggested an advantage of these systems is they encourage participation by students who would not ordinarily participate readily, because they are unsure of themselves, or perhaps there are other students in the class who tend to dominate, making participation too difficult for others (Webking & Valenzuela).

The PRS can stimulate discussion among students. Students will try to convince one another of the right answer, and the instructor can encourage such behavior, especially in an instance where there is great diversity of answers among the students in the room, or even if the majority of the students answered incorrectly (Webking & Valenzula, 2006). The instructor becomes vital in this discussion to moderate its level of educational value and keep the students on the topic at hand. Webking and Valenzula concluded that the PRS does in fact provide tools to improve the level and quality of the student's engagement in different sized classes. They allow instructors to actively encourage participation in a way that is comfortable for the students.

Popelka (2010) gave the student perspective of their attitude toward getting an incorrect response in the following statement:

Students know that the purpose of clickers is not to penalize them for getting the wrong answers; it is to encourage them to learn in an unintimidating and cooperative way, to help one another so that they make progress individually and as a group. (p. 293)

Students who understand they are not going to be penalized for an incorrect response are more likely to participate using the PRS. The instructor needs to pound that point across day one of PRS use. If successful, the PRS will provide students with immediate ability to expedite their learning curve, confidence, and understanding of the PRS.

## **Typical Characteristics of Questions**

By using multiple choice questions, an instructor can sometimes quickly measure student understanding. According to the Center for Teaching and Learning (1990), writing multiple choice questions should include the following rules:

-Write the correct answer immediately after writing the question. Make sure it is "unquestionably" correct.

-Make all responses the same length, style, complexity, and phrasing.

-Avoid composing alternatives that are "close to" the correct answer.

-Avoid using "all of the above" or "both A & B".

-Avoid using verbal clues that give away the correct response. (p. 3)

Questions are typically well thought-out prior to classroom instruction while preparing lecture notes or lesson plans. Preparing questions utilizing the PRS is just as simple as inserting a new slide into PowerPoint. Instructors can also add questions during lecture should concerns over student understanding or something else needs to be addressed with the class (Caldwell, 2007).

A number of studies have shown that the PRS has value for teaching and learning. d'Inverno et al. (2003) showed using it to deliver multiple-choice questions in mathematics led to improved concentration during lectures and greater enjoyment.

Cue (1998) used a table to show the traditional approach versus electronic approach to questions and answers in the classroom. Analysis of the table shows the electronic method helps eliminates bias in the classroom as well as an effective time saver. Table 1

| Task/Issue             | Traditional              | Electronic                              |
|------------------------|--------------------------|---|
| Question & answer      | Raise hands to be called | Answer in private with a keypad         |
| Collect answers        | One at a time-tedious    | Nearly parallel-in minutes              |
| Question type          | No restriction           | Alphanumeric<br>strings/multiple choice |
| Involvement            | A few students           | All students                            |
| Risk of embarrassment  | High                     | None                                    |
| Gender-blind           | No                       | Yes                                     |
| Color-blind            | No                       | Yes                                     |
| Feedback to lecturer   | Takes effort             | Convenient                              |
| Feedback/reinforcement | Occasional – some        | Histograms of responses-all             |
| Voting tabulation      | Manual                   | Automatic                               |
| Polling tabulation     | Manual                   | Automatic                               |
| Attendance check       | Manual                   | Automatic                               |
| Monitoring performance | Tedious                  | Convenient                              |
| Teaching style         | Lecture                  | Key on concept<br>clarifying questions  |
| Grading answers        | Manual                   | Software assisted                       |

Classroom Tasks: Traditional vs. Electronic

*Note*. From *A universal learning tool for classrooms?*, by S. Chu, 1998. Retrieved September 26, 2010, from The Hong Kong University Department of Physics Web site: http://celt.ust.hk/ideas/prs/pdf/Nelsoncue.pdf. Reprinted with permission of the author. As a teacher, bringing something new into your classroom requires some additional work. According to the Center for Research on Learning and Teaching (CRLT, 2010), the "Teaching with Clickers" section of their Web site has tremendous advice. The "Recommendations" section stated, as with any technological advance, the teacher needs to know how to use the clickers effectively. If the teacher is not well-prepared, the students realize in a heartbeat, possibly making the class a failure. One should also plan time to practice before actual classroom use so the teacher is able to work out the wrinkles in the new system.

Kift (2006) studied the PRS system by performing a case study. She noted that the use of the PRS technology broke up the traditional, passive lecture and got the students to relax and have some fun, without academic compromise. The future of learning and teaching is engaging students with these technological learning tools (Kift, 2006).

## **Recommendations**

Pelton and Pelton (2006) stated that the National Council of Teachers of Mathematics identified communication as one of the fundamental processes for learning mathematics. They discussed the old "chalk and talk" method in which a teacher lectures and the students take notes with little to no real discussion being promoted. Techniques that promote and support student participation yield students who pay more attention in class, perform better in the classroom and have fun learning (Pelton & Pelton). Based on their observations made during their study, they made the following recommendations:

-Be clear on objectives and the instructions given to students.

-Pilot questions before using them. A second set of eyes will help find poorly worded or poorly defined responses.

Try to encourage thoughtful assumptions. Make some questionspurposely ambiguous to leave room for students to make some decisions.Avoid jumping to show the correct answer.

-Have students explain why a particular response might be selected. This may or not be the response they chose.

-When a question yields varied responses, talk about it. "Convince your neighbor" works well.

-Not all questions need to have a preset correct answer. Let the students know that more than one answer may be correct or a "best" answer may be an option.

-Avoid using the timer with questions. Students seem to find it stressful.

(p. 182)

## **Summary**

Classrooms world-wide strive for ways to further engage students in the classroom. Throughout the research process, it became apparent that it is almost unanimous that the PRS is a positive, interactive tool to use in the classroom. The

PRS is used to promote student participation and engagement. The positive comments from students who witnessed this first hand were overwhelming compared to the few negative comments. The negative comments mostly dealt with technological glitches and not the personal response system itself as an educational tool.

Using interactive lectures, students are gaining control over the speed at which they learn as well as the content being instructed. An interactive lecture using the PRS involves all the students and returns immediate feedback to the class, as well as the instructor, to help guide the topic to point of the understanding.

Overall, clickers have the potential to improve student participation and engagement. "I never liked raising my hand in class. [Clickers] make me participate without having to rain my hand" (Popelka, 2010, p. 294-295). This quote shows what can happen when there is a lack of participation in today's classroom. Some students are scared to raise their hand and participate. The use of the PRS allows them to participate under the cover of remaining anonymous. Popelka shared that student engagement and participation naturally influence learning, increase engagement, and promote positive attitudes about mathematics. A majority of the research studies mentioned above have shown that the PRS can provide value for teaching and learning. My hope is that with the new methods presented, all students become more engaged in my Algebra I classroom and have fun with the additional technology available. I also believe that the use of the PRS will make me a better teacher. I will be able to teach at a higher level because I will be able to immediately assess student learning without spending time reviewing material they already know.

#### **Chapter Three**

#### **Research Design and Method**

The action research project will help determine whether use of the personal response system increases student participation and engagement in a high school mathematics Algebra I class. Further, I will describe student reactions to the use of personal response systems and determine whether students perceive the PRS to be a beneficial mathematics learning tool. Chapter three of my action research includes methodology of how the research will be designed and conducted.

## Setting

I currently am in my sixth year as a mathematics and chemistry instructor at a small Midwestern school with approximately 122 students in grades 7-12. In my first year as an educator, I was able to recognize that the same set of students were participating in classroom discussions, answering questions, volunteering to go to the board, etc. I felt lecture became redundant on a daily basis because the same students were getting involved day after day.

The participants of the research will be the Algebra I class which is the only section in the school. I will be the instructor of the class being studied. The participants are all freshman in high school and will consist of 14 students, 8 boys and 6 girls. My school recently purchased a set of "clickers" to go along with the newly installed SMART Board<sup>TM</sup>. I plan on implementing the personal response system into my Algebra I classroom to determine whether the PRS increases student participation and engagement in my classroom.

## Intervention/Innovation

Currently, my classroom is a typical mathematics classroom involving lecture and utilizing the SMART Board<sup>TM</sup>. I lecture about new material and then ask volunteers to go to the board to work out examples, or guide me in going through the problem together. I use the Notebook<sup>TM</sup> software, which allows me to create questions before class begins and also allows me the opportunity to print and save notes should students be unable to partake in lecture (i.e., being absent). The Notebook<sup>TM</sup> program is the SMART Board<sup>TM</sup> version of a word document.

During my action research project, each student will be given an individual "clicker" at the beginning of class. I will require all students to answer using the PRS. A majority of the questions will be multiple choices but there will also be some listing and fill-in-the-blank type questions.

Time will be a big factor in this project. An incredible amount of time is needed to make sure everything is working properly before a "live run" in front of the students. The first thing to do is to make myself familiar with the technology being used. I do not want the first day in front of the students to be my trial run with the system. Second, all questions will be created prior to the study using a program compatible with the SMART Board<sup>TM</sup>. Questions can easily be made up on the fly (i.e., while teaching) if more practice is needed or if questions arise, but the entire day's material cannot be typed up during class time or it will waste most of the period. Making the questions is, no doubt, time consuming. Once I have the material, I will always have it to use and revise if saved properly.

## Design

The action research project on the PRS will be a mixed-methods approach. I will keep a daily journal to document changes in student interaction and engagement in the classroom as well as observations and thoughts about my teaching methods. A journal will also be kept one week before the PRS is introduced to document a baseline for student interaction and engagement which will allow for comparison once the PRS is introduced. A pre- and post-survey (Joosten, 2004) will also be given to determine the students' opinions and personal insight of the "clickers" being brought into the Algebra I classroom (see Appendix A and Appendix B). As an action research study, I will use the results to learn more about my teaching and my students' learning while implementing the PRS. The results will not be generalized to other Algebra I classes.

#### **Description of Methods**

Three weeks prior to the start of the research project, the parental/guardian consent form and youth assent form (see Appendix C and Appendix D, respectively) will be sent home with the students to gain the approval of their

child being involved in data collection. It will be well noted that MSU's Institutional Review Board is in complete approval of the research and that the report will be confidential and the data collected will kept confidential. The school's principal also signed a permission letter approving the study be conducted in the school (see Appendix E).

Once the consent and assent letters have been turned in to me, the data collection process will begin with a pre-survey of the students to determine their experience, understanding, and knowledge of the "clicker" system we will be utilizing (see Appendix A). The system used will be the SMART Response PE Clicker from SMART Technologies<sup>TM</sup>. This PRS was chosen because it is available to me due to the school recently purchasing a set.

Daily questions and student's answers will be saved and analyzed each day to allow me to adjust my instruction to meet the needs of the students. Most of the questions will be multiple-choice, but there will still be problems which will be fill-in-the-blank. The daily journal will be kept by me to chart classroom interaction on a daily basis. Certain items I will watch for are the following: Are the students interacting with me as the teacher? Are students interacting with fellow students and discussing the answers when shown? Is the interaction positive, productive, and related to the mathematical content? Are the students becoming more engaged in the mathematics topic? The journal will also be used to document my reactions and thoughts about my teaching. I can write about the effectiveness of a lesson, changes for future lessons, difficulties and successes, and my thoughts about the study and students' responses to the PRS.

At the end of the third nine-weeks, a post-survey will also be given to determine students' level of interaction in my Algebra I class after implementation of PRS, whether they enjoyed their time utilizing the PRS in the Algebra I classroom, and whether they perceived the PRS to be a beneficial mathematics learning tool (see Appendix B). The survey will ask students for their opinions on the entire process. Did they feel it was more interactive during lecture? Were they engaged and having fun at the same time? It will be very interesting to see how their opinions compare to what I witness.

## **Expected Results**

My hope is that the students in my Algebra I classroom will be intrigued with the new technology. I expect my Algebra I students will enjoy the use of the PRS and the classroom will become much more interactive since everyone will be required to respond to a given question. I believe the more interactive a student becomes the more engaged he or she will be with the material and his or her learning. I also hope there is a direct correlation between productive discussions with increased engagement and student achievement, but achievement will not be measured as part of this study.

I would like the use of the personal response system to increase in our small school. My hope is to see it utilized in every classroom regardless of curriculum and discipline. I foresee some obstacles that may need to be overcome before class can continue. Those obstacles will deal with technology and the regular classroom. The technological problems that I am especially weary of include the following: What happens if the power goes out or I have computer difficulties? The regular classroom problems that may happen include the following: Even though answers will be confidential, will there be a problem with students making fun of particular answers that show up on the board? However, doesn't that problem arise in the typical lecture classroom as well? Once the discussions become more and more prevalent in the everyday classroom, will the students keep their discussions focused on the task at hand or will there be discussion tangent to another topic?

## **Timeline for the Study**

I will begin my study the first day of our second semester of class, which will begin the third quarter. The study will then be run for the entire third quarter, lasting nine weeks.

## **Summary**

As an educator, I believe all teachers can improve classroom participation, which should go hand-in-hand with making classroom lecture more interactive, more fun, and the students should learn something by doing it! The nine week action research project on the personal response system will determine whether the personal response system, in my Algebra I classroom, increases student participation and engagement. Chapter Four explained the data analysis and the results of the study.

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## Appendix A Pre-Survey

Personal Response System Pre-Survey Name \_\_\_\_\_

For each question, please mark the one most appropriate response for you based on your feelings, personal experiences, and opinions.

| 1. Indicate your op  | pinion of mathematic  | s.  |  |
|--|---|---|--|
| I hate math.   | I do not like math.   | Math is okay.   | I love math.   |
| 2. Indicate how of   | ten you currently day   | dream in Algebra I.   |  |
| I never daydream.  | I rarely daydream.  | I occasionally daydream.  | I frequently daydream.   |
| 3. Indicate why yo   | ou don't answer quest   | ions in Algebra I.  |  |
| I don't know<br>the answer.  | I am afraid of giving the wrong answer.   | I am shy and<br>don't like to speak<br>in front of others.  | I always answer questions.   |
| 4. Indicate how of   | ten you listen, on a d  | ay-to-day basis, in A   | lgebra I.  |
| I always<br>listen.  | I usually listen.   | I rarely listen.  | I never listen.  |
| 5. Indicate how of   | ten you take notes, or  | n a day-to-day basis,   | in Algebra I.  |
| I never take notes.  | I rarely take notes.  | I usually take notes.   | I always take notes.   |
| 6. Indicate how of   | ten you answer quest  | ions, on a day-to-day   | basis, in Algebra I.   |
| Lalwaya  |   |   |  |
| answer questions.  | I usually answer questions.   | I rarely answer questions.  | I never<br>answer questions  |
| answer questions.<br>7. Indicate the free  | I usually<br>answer questions.<br>quency with which yo  | I rarely<br>answer questions.<br>ou have used "clicker  | I never<br>answer questions<br>s" in school.                                   |
| <ul> <li>answer questions.</li> <li>7. Indicate the free</li> <li> Never</li> </ul>  | I usually<br>answer questions.<br>quency with which yo<br>A few times   | I rarely<br>answer questions.<br>ou have used "clicker<br>Often   | I never<br>answer questions<br>s" in school.<br>Everyday                       |
| <ul> <li>I always answer questions.</li> <li>7. Indicate the free Never</li> <li>If you answered "A continue the survey</li> </ul> | I usually<br>answer questions.<br>quency with which yo<br>A few times<br>few times," or "Ofte<br>below, starting with | I rarely<br>answer questions.<br>ou have used "clicker<br>Often<br>on," or "Everyday" in<br>question 8. | I never<br>answer questions<br>s" in school.<br>Everyday<br>question 7, please |

| 3. Indicate the class(es) in which you used clickers:                             |  |   |  |  |  |
|---|--|---|--|--|--|
| 9. Rate your abilit   | ty to use "clickers."  |   |  |  |  |
| None  | Weak   | Good  | Expert                                   |  |  |
| 10. Indicate the important classroom.   | pact you believe the u   | use of "clickers" brou  | ght to the                               |  |  |
| Very negative   | Negative   | Positive  | Very positive                            |  |  |
| 11. The use of the o  | clickers made class:   |   |  |  |  |
| More<br>enjoyable   | Less<br>enjoyable  | No different.   | I don't know.                            |  |  |
| 12. In your opinion attention in class  | , what did the use of ss?  | clickers do to your al  | bility to pay                            |  |  |
| Clickers<br>won't help me<br>pay attention.                                       | I already pay attention.   | Clickers will<br>help me pay<br>attention.  | I am not sure.                           |  |  |
| 13. When clickers a see the results. your confidence                              | are used to answer qu<br>Indicate how answeri<br>e in answer questions | estions in class, only<br>ing questions with cli  | the instructor can<br>ckers might impact |  |  |
| I will be less confident.   | I won't be confident.  | I will be a little more confident.  | I will be more confident.                |  |  |
| 14. What do you lil   | ke most about using t  | he clickers?  |  |  |  |
| Immediate<br>feedback – I will<br>know if my<br>answer is correct<br>immediately. | Using<br>technology to<br>learn math.                                  | Confiden-<br>tiality of my<br>responses – Only<br>the instructor, not<br>my classmates,<br>will see my<br>answer. | All of the above choices.                |  |  |

## Appendix B Post-Survey

Personal Response System Post-Survey Name \_\_\_\_\_

For each question, please mark the one most appropriate response for you based on your feelings, personal experiences, and opinions.

| 1. Indicate your op  | pinion of mathematic                    | s.   |                             |  |  |  |
|--|---|--|-----------------------------|--|--|--|
| I hate math.   | I do not like math.                     | Math is okay.  | I love math.                |  |  |  |
| 2. Indicate how often you currently daydream in Algebra I.                                   |   |  |                             |  |  |  |
| I never<br>daydream.   | I rarely daydream.                      | I occasionally daydream.                                   | I frequently daydream.      |  |  |  |
| 3. Indicate why yo   | ou don't answer quest                   | tions in Algebra I.  |                             |  |  |  |
| I don't know<br>the answer.  | I am afraid of giving the wrong answer. | I am shy and<br>don't like to speak<br>in front of others. | I always answer questions.  |  |  |  |
| 4. Indicate how of   | ten you listen, on a d                  | ay-to-day basis, in A                                      | lgebra I.                   |  |  |  |
| I always<br>listen.  | I usually listen.                       | I rarely listen.   | I never listen.             |  |  |  |
| 5. Indicate how of   | ten you take notes, or                  | n a day-to-day basis,                                      | in Algebra I.               |  |  |  |
| I never take notes.  | I rarely take notes.                    | I usually take notes.                                      | I always take notes.        |  |  |  |
| 6. Indicate how of   | ten you answer quest                    | ions, on a day-to-day                                      | basis, in Algebra I.        |  |  |  |
| I always answer questions.   | I usually answer questions.             | I rarely answer questions.                                 | I never<br>answer questions |  |  |  |
| 7. Indicate the free   | quency with which yo                    | ou have used "clicker                                      | s" in school.               |  |  |  |
| Never  | A few times                             | Often  | Everyday                    |  |  |  |
| 8. Rate your abilit  | y to use "clickers."                    |  |                             |  |  |  |
| None   | Weak                                    | Good   | Expert                      |  |  |  |
| 9. Indicate the impact you believe the use of "clickers" brought to the Algebra I classroom. |   |  |                             |  |  |  |
| Very negative  | Negative                                | Positive   | Very positive               |  |  |  |

| 10. The use of the c  | lickers made Algebra  | a I:  |  |
|---|---|---|--|
| More<br>enjoyable   | Less<br>enjoyable   | No different.   | I don't know.                            |
| 11. In your opinion attention in Alg  | , what did the use of ebra I?                                       | clickers do to your at  | pility to pay                            |
| Clickers<br>won't help me<br>pay attention.                                       | I already pay attention.  | Clickers will<br>help me pay<br>attention.  | I am not sure.                           |
| 12. When clickers a see the results. J your confidence                            | re used to answer qu<br>Indicate how answeri<br>in answer questions | estions in class, only<br>ng questions with cli   | the instructor can<br>ckers might impact |
| I will be less confident.   | I won't be confident.   | I will be a little more confident.  | I will be more confident.                |
| 13. What do you lik   | te most about using the   | he clickers?  |  |
| Immediate<br>feedback – I will<br>know if my<br>answer is correct<br>immediately. | Using<br>technology to<br>learn math.                               | Confiden-<br>tiality of my<br>responses – Only<br>the instructor, not<br>my classmates,<br>will see my<br>answer. | All of the above choices.                |

Please check the corresponding box that best agrees with your personal opinion and experience using the clickers in Algebra I the past nine weeks.

SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly Disagree

| Question   | SA | Α | D | SD |
|--|----|---|---|----|
| 14. Clickers made me feel involved in the course.      |    |   |   |    |
| 15. I had no problems using the clickers.              |    |   |   |    |
| 16. I am happy using the clickers.                     |    |   |   |    |
| 17. Clickers have been beneficial to my learning.      |    |   |   |    |
| 18. Using the clickers helped me to get a better grade |    |   |   |    |
| in this class.   |    |   |   |    |
| 19. Clickers led me to become engaged in class.        |    |   |   |    |

| Question  | SA | Α | D | SD |
|---|----|---|---|----|
| 20. Using clickers as a way of interacting is exciting. |    |   |   |    |
| 21. Clickers had very little impact on my learning.     |    |   |   |    |
| 22. Using clickers helped me to pay attention in        |    |   |   |    |
| class.  |    |   |   |    |
| 23. Clickers use is annoying.                           |    |   |   |    |
| 24. I wish more courses would use clickers during       |    |   |   |    |
| lecture.  |    |   |   |    |
| 25. Clickers allow me to better understand concepts.    |    |   |   |    |
| 26. The classroom environment was very lively and       |    |   |   |    |
| active thanks to the clickers.                          |    |   |   |    |
| 27. Using my clicker in class was simple.               |    |   |   |    |
| 28. I would recommend that the instructor continue      |    |   |   |    |
| to use clickers.  |    |   |   |    |
| 29. I got higher scores on my assignments because of    |    |   |   |    |
| the clicker.  |    |   |   |    |
| 30. Clickers did not stimulate interaction with my      |    |   |   |    |
| classmates.   |    |   |   |    |
| 31. I would hope the instructor would think twice       |    |   |   |    |
| about using clickers in the future.                     |    |   |   |    |
| 32. Clickers helped me get instant feedback on what     |    |   |   |    |
| I knew and didn't know.                                 |    |   |   |    |
| 33. The clickers motivated me to learn.                 |    |   |   |    |
| 34. Clickers increased my participation in class.       |    |   |   |    |
| 35. Clickers helped me think more deeply about          |    |   |   |    |
| course materials.                                       |    |   |   |    |

36. What did you like best about your experiences using clickers in this class?

37. If you could fix one thing about the use of clickers, what would it be?

## Appendix C Parental/Guardian Consent Form A Research Project by Thomas S. Milbrandt

## Invitation to Participate

Your child is invited to participate in a study of the use of the personal response system, or PRS, in the Algebra I classroom. The study is being conducted by Algebra I instructor, Mr. Thomas Milbrandt, a graduate student a Minot State University.

#### Basis for Subject Selection

You child has been selected because the Algebra I class is a very convenient sample due to the fact that I am your child's instructor, and with approximately 15 students, the class will allow the researcher to gather an appropriate amount of data to analyze.

## Purpose of the Research

I am completing work toward the Master of Arts in Teaching: Mathematics degree through Minot State University. As a degree requirement, I will be conducting a nine-week capstone research project in my Algebra I classroom this spring. I am going to analyze whether the use of a personal response system (PRS), or hand-held clickers, increases student participation and engagement. I will also describe whether students perceive the PRS to be a beneficial mathematics learning tool.

#### Specific Procedures to be Used/Duration of Study

Each student will be asked to complete a pre-survey regarding their current familiarity of the PRS as well as how they view their participation, interaction, and engagement in the current lecture-based Algebra I classroom. Research will take place for the entire nine-week period beginning with the start of the third quarter (January 14-March 21, 2011). A post-survey will be completed by the student participants to help gauge their opinions, whether positive or negative, with lecture changing to daily use of the PRS. While conducting the study, I will keep a daily journal to chart classroom interaction on a daily basis and to document my reactions and thoughts about my teaching. This process has been approved by Mr. Gary Milbrandt, Principal at Maple Valley. You may request to see any of the research instruments used in this study at any time.

#### Benefits to the Individual

The study may show the benefits of teaching mathematics by using the PRS instead of standard lecture practices. The results may be used to improve

instructional practices and therefore student learning in this mathematics classroom as well as others.

## Confidentiality

All data will be treated confidentially by the researcher. Names of participants and the data sets will be kept in a locked filing cabinet next to the researcher's desk. The researcher agrees to maintain strict confidentiality with regard to names, characteristics and other information on any person whose data may be seen as part of this research project so as not to conflict with State and Federal laws and regulations. Strict confidentiality means your student's name and any identifying information or characteristics, survey responses, question responses, comments, or other information about him or her will not be discussed or divulged in any manner with anyone outside of this research project. Furthermore, confidential information will not be discussed in a place where such a discussion might be overheard, nor will confidential information by discussed in a way that would allow an unauthorized person to associate or identify the student with such information.

## Voluntary Nature of Participation

During this study, the survey responses from your student do not have to be included. However, I hope you approve of your student being involved in this study because a large sample size improves the accuracy of the results of my study. If you decide to participate, you are free to withdraw your consent at any time. If you do not consent or withdraw your consent, your student will still use the PRS in class and will still take the survey, but your student's data will not be included in my results.

#### Human Subject Statement

The Institutional Review Board of Minot State University has given me permission to conduct this research. If you have questions regarding the right of research subjects please contact the Chairperson of the MSU Institutional Review Board, Brent Askvig, at 701-858-3052 or <u>Brent.Askvig@minotstateu.edu</u>.

#### Offer to Answer Questions

You should feel free to ask questions now or at any time during the study. If you have any questions please feel free to contact me by phone at 749-2570 or by email at <u>tom.s.milbrandt@sendit.nodak.edu</u> or the Principal, Mr. Gary Milbrandt at 749-2570. Thank you for your consideration.

#### Consent Statement

You are voluntarily making a decision whether or not to participate. Your signature indicates that, having read and understood the information above, you have decided to participate by allowing your student's survey responses to be used in this study. You will be given a copy of this consent form to keep.

Participant (Please print student name)

Signature of Parent or Guardian

Date

Researcher's Signature

Date

## Appendix D Youth Assent Form A Research Project by Thomas S. Milbrandt

## Invitation to Participate

You are invited to participate in a study of the use of the personal response system, or PRS, in the Algebra I classroom. The study is being conducted by your Algebra I instructor, Mr. Thomas Milbrandt, a graduate student a Minot State University.

#### Basis for Subject Selection

You have been selected because the Algebra I class is a very convenient sample due to the fact that I am your instructor and with approximately 15 students, the class will allow the researcher to gather an appropriate amount of data to analyze.

#### Purpose of the Research

I am completing work toward the Master of Arts in Teaching: Mathematics degree through Minot State University. As a degree requirement, I will be conducting a nine-week capstone research project in my Algebra I classroom this spring. I am going to analyze whether the use of a personal response system (PRS), or hand-held clickers, increase student participation and engagement. I will also describe whether students perceive the PRS to be a beneficial mathematics learning tool.

## Specific Procedures to be Used/Duration of Study

Each student will be asked to complete a pre-survey regarding their current familiarity of the PRS as well as how they view their participation, interaction, and engagement in the current lecture-based classroom. Research will take place for the entire nine-week period beginning with the start of the third quarter (January 14-March 21, 2011). A post-survey will be completed by the student participants to help gauge their opinions, whether positive or negative, with lecture changing to daily use of the PRS. While conducting the study, I will keep a daily journal to chart classroom interaction on a daily basis and to document my reactions and thoughts about my teaching. This process has been approved by Mr. Gary Milbrandt, Principal at Maple Valley. You may request to see any of the research instruments used in this study at any time.

#### Benefits to the Individual

The study may show the benefits of teaching mathematics by using the PRS instead of standard lecture practices. The results may be used to improve

instructional practices and therefore student learning in this mathematics classroom as well as others.

## Confidentiality

All data will be treated confidentially by the researcher. Names of participants and the data sets will be kept in a locked filing cabinet next to the researcher's desk. The researcher agrees to maintain strict confidentiality with regard to names, characteristics and other information on any person whose data may be seen as part of this research project so as not to conflict with State and Federal laws and regulations. Strict confidentiality means your name and any identifying information or characteristics, survey responses, question responses, comments, or other information about you will not be discussed or divulged in any manner with anyone outside of this research project. Furthermore, confidential information will not be discussed in a place where such a discussion might be overheard, nor will confidential information by discussed in a way that would allow an unauthorized person to associate or identify the student with such information.

## Voluntary Nature of Participation

During this study, your survey responses do not have to be included. However, I hope you will participate in this study because a large sample size improves the accuracy of the results of my study. If you decide to participate, you are free to withdraw your consent at any time. If you do not consent or withdraw your consent, you will still use the PRS in class and will still take the survey, but your data will not be included in my results.

## Human Subject Statement

The Institutional Review Board of Minot State University has given me permission to conduct this research. If you have questions regarding the right of research subjects please contact the Chairperson of the MSU Institutional Review Board, Brent Askvig, at 701-858-3052 or Brent.Askvig@minotstateu.edu.

#### Offer to Answer Questions

You should feel free to ask questions now or at any time during the study. If you have any questions please feel free to contact me by phone at 749-2570 or by email at <u>tom.s.milbrandt@sendit.nodak.edu</u> or the Principal, Mr. Gary Milbrandt at 749-2570. Thank you for your consideration.

## Consent Statement

You are voluntarily making a decision whether or not to participate. Your signature indicates that, having read and understood the information above, you

have decided to participate and allow your survey responses to be used in this study. You will be given a copy of this consent form to keep.

Participant (Please print student name)

Signature of Student

Date

Researcher's Signature

Date

## Appendix E Principal Permission Letter

Maple Valley High School 206 Broadway Street/Box 168 Tower City, ND 58071

Dear Mr. Gary Milbrandt:

I am completing work toward the Master of Arts in Teaching: Mathematics degree through Minot State University. As a degree requirement, I need to conduct a capstone research project in my classroom this spring. The topic for my project involves the use of the personal response system (PRS) in conjunction with the SMART Boards<sup>TM</sup>. I will monitor whether the use of the PRS increases student participation and engagement in my high school Algebra I class. Further, I will describe student reactions to the use of personal response systems and determine whether students perceive the PRS to be a beneficial mathematics learning tool. It is my intent that after the completion of the study, all mathematics courses may have the opportunity to reap the benefits of the PRS.

Each student will be asked to complete a pre-survey regarding their current familiarity with the PRS as well as how they view their participation, interaction, and engagement in the current lecture-based classroom. I wish to perform this research for the entire nine-week period beginning with the start of the third quarter (January 14-March 21, 2011). A post-survey will be completed by the student participants to help gauge their opinions, whether positive or negative, with lecture changing to daily use of the PRS. I will also be keeping a journal and report my findings from an instructor's perspective as well.

Survey responses and my journal entries will be analyzed and the results will be included in my research paper; however, no individual participants will be identified by name. Standard classroom confidentiality will be observed regarding all data collected. I am able to view student responses but their fellow classmates will not have that availability. Students will understand that their responses cannot be held anonymously, but will be kept confidential.

I have prepared a letter to notify parents of this project and am asking for their permission to use the surveys completed by their student in my study. A copy of this letter, as well as the student consent form, is attached for your inspection. I am requesting that you permit me to carry out this research in my classroom and to include your name in my letter to parents. Please contact me if you have any questions. Thank you for your consideration.

Sincerely,

Thomas S. Milbrandt

\_\_\_\_ Permission for Thomas Milbrandt to conduct research in his classroom is granted.

\_\_\_\_ Permission to conduct this study is denied.

Signature

Date \_\_\_\_\_

Mr. Gary Milbrandt Maple Valley High Principal