STUDENT RESPONSE SYSTEMS IN THE ELEMENTARY CLASSROOM:

ASSESSING THE EFFECTIVENESS

OF FORMATIVE FEEDBACK

A Thesis Presented to the Faculty
of
California State University, Stanislaus

In Partial Fulfillment
of the Requirements for the Degree
of Master of Arts in Education

By
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November 2013
CERTIFICATION OF APPROVAL

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DEDICATION

This thesis is dedicated to my wonderful family. First, to my husband who has always been so supportive of all of my dreams and aspirations. When informing him that I wanted to begin the Master’s program, there was no hesitation; he encouraged it right away despite the time and money commitment. Secondly, to my parents who have always inspired me that I can be whatever I put my mind to. They always remind me of all I am capable of and hold me to the highest expectations that all parents should for their children. To them, I owe my thanks and appreciation.
ACKNOWLEDGEMENTS

Acknowledgements must be made to my colleagues at my school. Each and every one of them inspires me to be a better teacher every day. Their support and listening ears have helped me through the busiest and toughest times over the last few years. To my grade level partner, who let me borrow her class to complete this research, I owe much appreciation.

Another person that must be acknowledged is my thesis advisor, Dr. Myhre. He has helped to make this process smooth and simple. For this, I am very grateful. His help and guidance was timely and detailed and helped me to reach my goals sooner than I expected.
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ABSTRACT

This study investigated the impact that student response systems may have on mathematics achievement in third grade classes at a school in California’s Central Valley. Teachers are often seeking ways in which to check students’ understanding during a lesson, and use of “clickers” is gaining interest among K-12 teachers as a tool that can provide timely feedback on instruction and help facilitate the learning process. This study compared two third grade classes’ results on math chapter tests when one class used clickers during the lessons and the other class did not. The results did not support that clickers made a difference when it came to student learning as measured by the two third grade math chapter tests that were part of this study.
CHAPTER I
INTRODUCTION

Within every lesson that is taught, teachers have opportunities to include activities and technologies that potentially enhance student learning. One feature of instruction that is desired by teachers and students alike is immediate and corrective feedback. Actionable and timely feedback during a lesson can help students and teachers make better instructional decisions in support of the learning process. The responses and answers that teachers receive from the students are “a golden opportunity to reinforce instruction or to give positive corrective feedback” (Sponder, 1993, p. 22). They provide opportunities for the teacher to make decisions immediately to redirect, reteach, or expand. For students, feedback helps confirm whether they are meeting their learning goals and can “increase their motivation to learn and their desire to perform” (Sponder, 1993, p. 22). For teachers, the feedback received from students enhances the learning process as teachers are able to use this information to guide and direct the instruction (Hepplestone, Holden, Parkin, & Thorpe, 2011, p. 117).

Effective feedback has two characteristics. First, the sooner the feedback can be given to students, the more powerful the effect for teachers and students. This is called “timely” feedback (Hepplestone et al., 2011, p. 117). Another component that makes feedback effective is when it is corrective and positive (Sponder, 1993, p. 19). In order for feedback to truly enhance learning, the teacher must “acknowledge, and
build upon, what students already know instead of focusing on their mistakes. Then, reteach the poorly understood operation by showing them how to proceed” (Sponder, 1993, p. 20).

One tool that has become increasingly popular and available for teachers to gain feedback from their students and also make that feedback accessible for students, is classroom student response systems (SRS), also known as “clickers.” Research has shown that “learning technologies can encourage better engagement with feedback” (Hepplestone et al., 2011, p. 118). Although there are many different forms of hands-on technology available for student use, SRS specifically focus on the use of immediate and corrective feedback that students and teachers can use to further the learning process. Research has shown that using “clickers” in the classroom can improve learning when compared with lessons that provide no immediate feedback (Fallon & Forrest, 2011, p. 195).

**Statement of the Problem**

Checking for understanding, giving student feedback, and redirecting within a lesson are all components of Direct Instruction. This instructional method has been adopted by many school districts, including the one in which this study takes place (National Institute for Direct Instruction, 2013). The district has provided substantial training for teachers in direct instruction and the use of technology. The goal of the district is to have all teachers certified in direct instruction within the next couple of years. One of the most important components of direct instruction is the need to check for understanding in order to reteach or extend the information that is being
taught as part of the lesson (National Institute for Direct Instruction, 2013). This requires the teacher to ask questions and check for understanding throughout the lesson and provide students with opportunities to respond and interact with the content. Individual whiteboards are traditionally considered the primary form of student teacher interaction and checking for understanding during teaching.

Using whiteboards can prove problematic in regards to timing and function since the time it takes for students to write down answers and for the teacher to check the various responses in the class might result in delayed information to both the teacher and student. The use of whiteboards might also prevent participation and assessment from many students, since students often simply copy what others have written. Such practices have a tendency to lower students’ engagement.

However, with student response systems, some of these problems can be solved. For example, when using SRS, the teacher can gain information about student learning almost immediately following specific instruction. The technology also ensures accountability for students since the answers are their own and not copied from other students.

Studies have shown the boys tend to be more engaged than girls through the use of technology (Gok, 2011; Kay, 2009). However, most of these studies on perspectives and influence of technology have been conducted with university level students. Little research has been completed in elementary school to investigate how gender and SRS technology affects student achievement.
The charter school in which this study takes place is considered a school of technology and the administration has had as one of its goals to be the most technologically advanced school in the area. There has recently been a purchase of student response systems through the e-Instruction company for each grade level. Along with the student response systems, each teacher received sets of mobile interactive whiteboards (Mobi 360) that interact with the SRS and can be used to create questions throughout the lesson to send to the students’ SRS. The first goal of incorporating this technology is to increase the amount of time that students spend with technology in their hands. Secondly, the school wants to improve the ability to check for student understanding with the use of technology. A goal of this research is to provide necessary data and information that can aid the administration as to whether or not the purchase of this type of technology facilitates student learning.

**Purpose of the Study**

The purpose of this study is to determine how the use of student response systems as an immediate feedback tool within direct instruction lessons for third grade students at a technology and arts charter school impacts the outcome of students’ summative assessment when compared to lessons and assessments without the use of SRS. The purpose of this study is also to determine how the use of student response systems will impact the summative assessment based on gender.

**Significance of the Study**

The importance of student feedback and formative assessment within the classroom and how such practices influence student learning is well documented
(Brosvic, Epstein, Dihoff, & Cook, 2006; Dihoff, Brosvic, Epstein, & Cook, 2004; Peterson & Siadat, 2009). However, with modern technology constantly changing and transforming, it is important to research whether these new technologies can help to support feedback and assessment within the classroom. A significant amount of research has been completed on the use of student response systems in the classroom and how such technologies affect engagement as well as feedback that leads to academic gains (Bartsch & Murphy, 2011; Gok, 2011; Kay, 2009; Miller & Felson, 2009). However, much of this research has taken place in high school and college level classrooms (Hepplestone et al., 2011). Very little research has attempted to measure how effective these systems are in elementary classrooms. This research will focus on younger students and explore how feedback with the help of “clickers” within a lesson affects their chapter test scores.

The findings of this study might be of interest to elementary teachers and administrators. The results can potentially help elementary teachers identify a method and tool that will increase student feedback during lessons. Teachers and administrators will also be able to determine to what degree the use of SRS improves student learning as measured by chapter tests. Such information is useful when deciding on an instructional tool to invest in for their elementary school sites.

The following questions and hypotheses will be tested in this study: Research Question 1: Is there a difference in academic performance as measured by chapter tests between third grade students receiving individual immediate feedback using student response systems and students who are not taught using student response
systems? Hypothesis 1: There is no difference in academic performance between a third grade class using student response systems and a comparison class not using an immediate feedback tool as measured by chapter tests. Research Question 2: Does gender influence how the use of student response systems affects academic performance of third graders as measured by chapter tests? Hypothesis 2: There is no difference between girls and boys when it comes to how student response systems affect academic performance of third grades as measured by chapter tests.

Definition of Terms

*Formative Feedback.* This type of feedback is used during the lesson as part of the learning process prior to a summative assessment. This feedback is used by the teacher to direct instruction and given to the students to direct learning.

*Student Response Systems (SRS).* This is a technology system, often referred to as “clickers,” in which students have handheld electronic devices that can send data to the teacher’s computer in order to collect data.

*Summative Assessment.* This refers to any type of assessment given at the end of a unit of instruction. In this study, it is the chapter test that follows a week (four lessons) of a chapter in math.

Summary

Chapter I introduced the research problem and the research questions for the study. Many school districts are focusing on teaching practices that include checking for understanding and providing immediate and corrective feedback to students. The potential for clickers in the classroom to provide this type of instructional support is
important to teachers of all grade levels. However, most of the research on the use of student response systems has been in secondary and university level classrooms. This study will seek to investigate whether the use of student response systems can be an effective tool for instruction at the elementary level.

The next chapter will present previous research related to three areas related to the use of SRS. The topics will include the importance of formative feedback, perspectives on, and effectiveness of student response systems. Subsequent chapters will describe the research method, the analysis of the data, and, finally, discussion of the findings.
CHAPTER II
REVIEW OF THE LITERATURE

Corrective and immediate feedback has long been a goal for teachers as a formative assessment tool. Recently, student response systems have become popular, especially in college classes. Research on student response systems have mostly focused on how such technologies affect attendance, classroom interaction and engagement, and test scores (Kenwright, 2009). This review of literature will first present the theoretical framework for the study, followed by literature on the relationship between immediate feedback and student performance. Next, the review will focus on student and teacher perspectives on the use of student response systems as tools for feedback. Last, studies on the effectiveness of student response systems will be discussed.

Theoretical Framework

Miller’s (1956) theory of Information Processing defines the importance of feedback during instruction. He concluded that humans learn things in “chunks” that allow us to keep information in our short term memory and that the mind can only handle up to five to nine pieces of information at a time. Miller, Galanter, and Pribram’s (1960) work built on Miller’s previous work and defined the concept of Test-Operate-Test-Exit (TOTE), which is basically a continuing cycle of feedback and redirection. The learning process requires a constant interaction between testing a goal to see if it has been reached and if not, continuing to pursue achieving that goal.
until it is fulfilled or rejected (Miller, Galanter, & Pribram, 1960). In the classroom, this theory would be demonstrated by teachers checking whether students have understood the learning goal, if not, continue teaching, check again, then redirect or stop teaching if and when the learning goal had been reached.

Teachers can apply the first part of Miller’s theory within a lesson by chunking the components of a lesson (which could be the steps, information, or facts presented) and stopping periodically to allow students to reflect and respond to the pieces that have been presented. The use of student response systems can easily be used to help the teacher to chunk information appropriately. By including periodic questions probing for students’ understanding, the teacher has to think about how to chunk the lesson into logical parts. These same questions also provide the basis to Test-Operate-Test-Exit (TOTE) during instruction. The teacher constantly checks for understanding and either continues reteaching until students reach the learning goal or redirect the lesson completely. The use of SRS can facilitate this cycle of teach, test, reteach, test and so on until mastery has occurred.

Skinner’s (1938) theory of Operant Conditioning described how people become habituated to responding to stimuli in a particular way based on the feedback and reinforcement they received. The reinforcement could be anything that would confirm the expected response. This reinforcement could be positive or negative. Negative reinforcers were called punishers. The difference being that positive reinforcement increased the desired behavior, whereas negative punishers decreased a behavior. Skinner also placed an emphasis on how quickly an individual received
reinforcement. The more immediate the feedback, the more likely it was to have an effect on behavior or responses. Along with the immediacy of feedback, Skinner also believed that feedback should occur at small steps throughout a lesson (Skinner, 1954).

The use of SRS within a lesson can potentially provide students with the immediate feedback that they might need to reinforce their thinking. Receiving immediate recognition that they had a correct answer should theoretically increase the likelihood that they would continue the behavior that awarded them the right response. If they receive the immediate feedback that they did not get the answer correct, it will hopefully help them reflect on the behavior that caused them to make a mistake. Using SRS also forces the instructor to constantly stop after small steps to check on the students and provide reinforcement on whether or not their learning is on track to meet the overall goal of the lesson.

**Immediate and Corrective Feedback in the Classroom**

It is important to understand how teachers and students feel about this feedback in the classroom. Burnett and Mandel (2010) set out to explore the perspectives of teachers and students in regards to praise and feedback in the classroom. The study employed a qualitative case study methodology involving observations and interviews. The specific research questions sought to gather information about students’ perspectives of and responses to praise, teachers’ perspectives of praise and feedback, and the frequency of this praise and feedback. The study involved 56 students (30 boys and 26 girls) that ranged from first to sixth
grade who were randomly selected from an elementary school in rural Australia. The interviews were either one-on-one or group interviews. One male and four female teachers participated in the study. The semi structured interviews were recorded and then transcribed. During the four hours of observations per teacher, the researchers’ assistant used the Structural Observational Schedule based on Observing Pupils and Teachers in Classrooms from other research on this topic. This was modified to include the subjects of praise and feedback in the classroom. The feedback statements were categorized into four areas: ability feedback, effort feedback, general praise, and negative statement (Burnett & Mandel, 2010).

The first set of results was related to the student perspectives of praise and feedback. First, the researchers found that younger students (those in grades 1 and 2) preferred feedback that was related to their behavior. However, as students were older, they changed to prefer that teachers praise them for academics and effort. All but one student indicated that they enjoyed being praised and receiving feedback. In regards to the type of feedback, students preferred (57%) to receive effort feedback rather than ability feedback. Of the students interviewed, 60% said they liked to be praised publicly. The results from the teacher interviews showed a range of perspectives. The teachers had differing views on the types of feedback they used as well as the purpose and value of this type of behavior. The observations provided clarifying information. The most common type of praise found in the classroom was general praise that did not target a particular skill/topic (ranging from 71% to 93% of all feedback). Effort and ability feedback was used only less than 10% of the total
feedback given. The feedback the teachers gave was 89% positive and 11% negative. The average number of times that teachers gave feedback within an hour was 40 times (Burnett & Mandel, 2010).

A study exploring feedback by Dihoff et al. (2004) investigated the use of immediate feedback compared to delayed feedback and its results on student academic performance and retention. The research included two different studies. The first study explored how immediate and self-corrective feedback affected the retention of subject matter for students. The second study investigated which type of feedback influenced retention. Three types of feedback related to timing were investigated by the study: immediate, end of test, or 24-hour delay. The first study consisted of a sample of 47 male and 73 female students from an undergraduate college class. The students were given one of two practice tests. The first practice test used an answer sheet called Immediate Feedback Assessment Technique (IF AT) which allowed students to scrape off their answer, like a lottery ticket, and see immediately whether their answer was correct by seeing if there was a symbol under the surface. If these students did not see a symbol, they could keep scratching until they found the correct answer. The second test, which was considered the control, used a regular scantron in which students did not receive any type of feedback. On the final exam, students also completed a questionnaire indicating their confidence on each answer and other questions related to the process of feedback and testing preparation. In the second study, researchers investigated 32 male and 48 female students from an undergraduate college class. Twenty of these students were
randomly assigned to four different conditions on a practice test to prepare for a class exam. The first group (the control group) answered the practice test items on a scantron, with no feedback provided on their answers. The second group was assigned to the “end-of-test feedback condition” and they also used a scantron; however, they were allowed to review their answers at the end of the test without being able to change answers (p. 220). The third group, the delayed-feedback group, also used a scantron. This group received their answers and had time to review the day after the practice test. The last group, the immediate-feedback group, used the IF AT form during their practice test. A final exam using a scantron for all students was given two weeks after four practice tests and quizzes. Students also completed a questionnaire about their confidence on the tests (Dihoff et al., 2004).

The results of the first study showed that students who had received feedback from the IF AT scored significantly higher than the control group on their exams ($F > 11.27, p < .0001$). The study also found that students who received feedback were more likely to get a question right on their first attempt ($p < .001$), or on their second attempt after getting the question wrong on the first attempt. From the questionnaire, researchers were able to conclude that students who used the IF AT voiced higher satisfaction with the response format than those in the scantron group ($M = 4.14$ compared to $M = 2.78$) as well as the benefits of testing ($M = 4.55$ compared to $M = 2.64$). The results of the second study provided more specific results on type of feedback. A repeated-measures ANOVA was used to analyze the different exam responses of the different groups, which found that there were significant differences
in results based on the feedback types \( (F = 34.87, p < .0001) \). The group with the highest scores was the one that used the IF AT, which provided immediate feedback. The delayed and end of test feedback groups were the next highest scores. The lowest scoring students were those that used only the scantron with no feedback. Students who received immediate feedback also indicated more satisfaction with the format and type of testing \( (F > 4.39, p < .001) \) (Dihoff, et al., 2004).

These same researchers, Brosvic et al. (2006), completed another study investigating how the timing of feedback affected retention of knowledge, but this time in a laboratory setting. The researchers used an artificial language called Esperanto that students would learn in a laboratory setting. The students who participated, 20 male and 80 female students around 19 years old that were enrolled in undergraduate college classes, attended lectures and had exams in a laboratory similar to those in a regular classroom setting. The researchers used five different exams leading up to a final exam that tested the knowledge of the students on the language Esperanto. There were ten different groups designed by researchers to test different types of feedback and response conditions. Ten participants were assigned randomly to each of those ten groups. There were four types of feedback conditions within those groups: no feedback, 24-hour delayed feedback, end of test feedback, and immediate feedback using the IF AT form (Brosvic et al., 2006).

The results, based on an analysis of variance, showed no significant differences on the in-class exams leading up to the final exam \( (F < 1, p > .5) \). However, on the final exam, students who received immediate feedback had higher
scores than any other group ($p < .005$). These students also had higher retention in
weeks 2 through 10, as well as 3 and 6 months later, when receiving immediate
feedback on in-class exams ($p < .005$) (Brosvic et al., 2006).

Bakula (2010) investigated the importance of formative assessment on the
results of summative assessment. The researcher completed the study with her own
seventh-graders. She gave the formative assessment to all of her 95 students.
However, she only collected data from one of the five classes, which included 19
students of mixed gender and ability. There were six different formative assessments
given, of which five were using paper and pen and one was a performance based task.
After the results were received by the researcher, certain topics within the lesson were
retaught. A final summative assessment was given to students upon completion of the
appropriate lessons. The researcher analyzed the results of the formative assessment
question by question to help understand the students’ learning and better reteach the
concepts.

During the analysis phase, the researcher analyzed the overall results of all of
the formative assessments and compared that to the scores received on the summative
assessment. The results were categorized into high, medium, and low based on the
expected levels as compared to the state standards. In the high category, students
were able to improve their scores from the formative to the summative assessment
(57% compared to 84%). The number of medium scores decreased from 31% to 6%.
The number of low scores changed slightly from 13% to 11%. This demonstrated that
some students were able to move from the medium level to the high level on the
summative assessment, which indicated an increase in knowledge. On one particular question, however, 57% of students decreased in their understanding of density. Although detailed statistical analyses were not conducted on these results, the overall percentages showed an increase in understanding from the formative to the summative assessments.

Peterson and Siadat (2009) investigated the interaction between formative and summative assessments and the effect on students’ achievement in Algebra classes. The researchers hoped to discover whether increased formative assessment produced higher results on summative assessments. The study involved 1,574 students with 25 different instructors. The students were all enrolled in Algebra courses that contained the same elements from class to class including the same midterm/final and standardized tests. The only differences in the classes were the changes in amount of formative assessment for the purpose of the study. Students involved in the test group included 10 sections that were taught by two different teachers using the Keystone methodology. The control group that received a traditional style teaching was a combination of 50 different sections of the course with 23 different teachers. Within the test group, there were two sub-groups. The first group received weekly quizzes while the second group received a quiz each class, which resulted in two quizzes each week. The resulting data was converted to percentages to be able to compare variances. The researchers also analyzed frequencies, means, standard deviations, and other descriptive statistics. A t-test was also used to find any differences between groups (Peterson & Siadat, 2009).
After completing the summative evaluations, the data showed that students who were in the test group increased their summative evaluation more than those in the control groups, although all groups increased on the summative evaluation. The biweekly group appeared to have made the largest gain from the pretest mean of 19.9 to the post-test mean of 34.1. This was in comparison to the weekly formative assessment group of 20.0 to 33.0 and the control group scores of 20.3 to 28.3. The comparisons between the weekly test group and the control was significant ($t(306) = 1.98, p<.05$) as well as the difference between the biweekly test group and the control group ($t(335) = 3.67, p<.05$). The difference in results between the two test groups was not significant ($t(67) = 0.422$). From these results, it appears that the more formative feedback that students received, the better they did on final summative assessments (Peterson & Siadat, 2009).

**Student and Teacher Perspectives on Feedback and Effects of Response Systems**

An important aspect of research related to the use of student response systems in the classroom is the perspective and viewpoint of those who have already used them. One study that investigated teacher and student viewpoints was completed by Gok (2011). This study was designed to explore the experiences of both instructors and students in a university classroom that used “clickers.” Four research questions guided the study that covered how the instructors described their experience using the clickers, whether these instructors were aware of their students’ cognitive development, how students reported their experience, and how males and females differed in their attitudes toward SRS (p. 71).
To search for possible answers to these questions, the researcher selected, through email requests and snowball selection, six different faculty members that varied in experience and disciplines (three males and three females). A total of twelve students ranging from freshmen to seniors were also recruited from an in-class announcement to participate in the interviews (six females and six males). Also, 523 volunteer students completed the SRS attitude survey (241 males, 262 females). The researcher observed one lesson for each instructor using the clickers. After the observation was complete, a date was set to interview the instructor for 30 minutes. The students that participated were interviewed individually or in small groups for 25 minutes. Lastly, the SRS survey was completed by the volunteer students to examine gender differences. The observation and interviews were evaluated using the phenomenological approach, whereas the survey was analyzed using a MANOVA.

To increase the reliability of qualitative analysis, the researcher employed “triangulation, prolonged engagement, peer review, member checks, thick description, and clarification of researcher bias” (Gok, 2011, p. 73).

The results of this study revealed that the instructors and students had mostly positive viewpoints regarding the use of student response systems. Instructors felt that the clickers made the classroom environment more engaging and supportive to learning. In fact, the results showed that instructors felt that the clickers “generate discussion because students can see immediate feedback as to the responses of the entire class” and also that they allowed the instructor to begin “modifying their presentation of the content on the spot” (Gok, 2011, p. 74). This classroom discussion
following clicker questions and responses was also noted by Gok (2011) during the observations. The only negative feelings reported by instructors were the technical issues that sometimes occurred while using the response systems. The student interviews varied in the benefits and concerns that students felt. All students were able to discuss some benefits that resulted from using the clickers. One of the benefits agreed upon by the students was the feedback they were able to receive from the use of the clickers. Some students even believed that the use of the response system “improved their learning and added to the level of cognitive thinking required in the classroom” (p. 78). The students also agreed that more instructors should use clickers during instruction. The only significant concern was related to technical difficulties related to the instructor during class time. The survey results revealed that male students ($M = 56.5, SD = 9.2$) had more positive opinions about the clickers than female students ($M = 52.1, SD = 10.1$) (Gok, 2011).

Another study that investigated viewpoints about student response systems was completed by Penuel, Boscardin, Masyn and Crawford (2006). However, this study focused only on teacher perspectives and those teachers ranged from elementary to secondary schools (K-12th grade). Instead of investigating the perspectives of the results of using clickers, this research explored how teachers were actually using the clickers in the classroom. The research questions focused on the purposes of using clickers, possible “profiles of use,” whether these profiles might be specific to certain types of teachers and classrooms, and whether or not teacher perspectives on the prospective outcomes of clickers influenced how they used them.
The researchers recruited 584 K-12 teachers who all used the same type of clickers in the classroom through the use of a company newsletter and representatives from the company. Those that participated in the survey were 35.7% elementary, 29.7% middle school, and 34.4% high school teachers. The survey consisted of six different sections of questions ranging from demographics, use of clickers, goals, beliefs, to perceived effects. The researchers used a categorical exploratory factor analysis (EFA) and latent class analysis (LCA) to analyze the data from the survey.

The results of the questionnaire revealed some important teacher uses and perspectives. First, the survey revealed that teachers have some common goals when using clickers. Teachers “tended to value both instructional improvement and assessment goals equally” (Penuel et al., p. 328). Teachers most often used the clickers to check for understanding of the subject matter content during instruction, which refers to teachers gaining feedback from students about their learning. The survey also revealed that teachers also used the results from the clicker responses to develop classroom discussions. In fact, teachers felt that these discussions were what made the clickers “more effective in the classroom” (p. 342). The most agreed upon perceived effects of the clickers were more timely data for teachers (.80), better quality assessment data for teachers (.72), and teacher awareness of conceptual understanding (.70) (Penuel et al., 2006).

Kay (2009) not only sought to investigate the attitudes towards SRS, but also the gender differences. This study surveyed 659 secondary students (327 male, 327 females) in grades 9 through 12. Of this sample, 87% (n = 572) claimed to be
comfortable or very comfortable with technology. The students were enrolled in a variety of 23 different classes ranging from technology to math to social studies.

Twenty-three teachers received training and materials needed in order to teach using the SRS as much as desired by the teacher. Students participated in lessons using SRS for a three month period. At the end of this period, students who had submitted a signed permission slip from parents completed a nine question, seven-point Likert scale survey regarding the last month of SRS lessons. This survey had an internal reliability of 0.89. A coding scheme was used to analyze the students’ comments to the question related to how the SRS impacted their learning. The comments were assigned to a five-point Likert scale by two raters who had an inter-rater reliability of 83% for categories and 93% for ratings. Three different types of feedback using the SRS were studied: formative, mixed, and summative. The research questions included examining the difference between the genders in their attitude toward SRS, how computer comfort level impacted the gender differences, and how the type of use of the SRS impacted the attitudes (Kay, 2009).

The results of the study showed that there was a difference between genders when analyzing attitudes towards SRS. Male attitudes ($M = 46.1$, $SD = 9.5$) were significantly more positive than females ($M = 42.5$, $SD = 10.4$) in regards to their outlook on using the SRS ($t = 44.93$, $df = 615$, $p < 001$). A MANOVA was completed to analyze the individual items on the survey. In all but one of the questions, male and female attitudes were significantly different. Male attitudes were more positive with regards to motivation and engagement, increased participation, enjoying using SRS to
test knowledge, believing that SRS increased classroom discussion, improved learning using SRS, and the thought that classes that used SRS were better than others (Kay, 2009). Female students were significantly higher ($M = -1.35$, $SD = 0.71$) in reporting that they felt “stressed” when using SRS ($t = 4.52$, $p < .001$). Compared to females ($M = 3.05$, $SD = 0.70$), male students ($M = 3.47$, $SD = 0.67$) also had significantly higher computer comfort scores ($t = 7.83$, $df = 650$, $p < .001$). A MANOVA was run to analyze differences in attitude on the survey using computer comfort as a covariate. The results showed that there was still a significant difference between males and females with males having a more positive attitude toward SRS (Kay, 2009). A chi square analysis was also completed to determine differences in attitudes regarding the type of use. Significant differences between males and females was found ($X^2(2, N = 649) = 10.60$, $p < .01$). Male students reported more use of formative feedback (71% for males, 62% for females) from the SRS while females reported more summative use of SRS in the classroom (21% for females, 11% for males) (Kay, 2009).

Nagy-Shadman and Desrochers (2008) investigated student perspectives of student response systems. The researchers asked questions ranging from student perspectives on whether the response systems enhanced learning, which features had an influence on their learning, to how students who use these systems compared to those who did not in relation to their experiences in the classroom. The study was completed at California State University, Northridge in earth and physical science classes and involved 350 participants who were students from three different classes.
at the university over three semesters. The courses were taught by five different teachers. There were a total of 13 classes that participated in the research. In order to increase reliability, researchers used a weighted mean response for each question to be sure results were similar across multiple instructors.

The results indicated that students felt that these systems supported the learning process. In fact, 74% believed it was “an effective teaching and learning tool” (p. 2032) and 61% believed that it helped provide feedback on how much they understood the concept. A little over half of the students (58%) felt that the remotes helped them to “internally monitor their own understanding of concepts during class” (p. 2032). In regards to the questions on classroom engagement, the researchers compared the results of the questions to another study that was done with a random group of students at a university. The results of this comparison showed that students who used the response systems did score slightly higher in engagement and their perception of getting immediate feedback from the professor (M=2.86 compared to M=2.27). After analyzing the short answer responses, one common feature that students liked about using the clickers, among others, was receiving immediate feedback and the ability to practice with the class content. The last significant result from the study was that 79% of students were satisfied with using the system and 94% would recommend using the technology in the future. Only 2% of the students reported feeling poorly satisfied with using the clickers (Nagy-Shadman & Desrochers, 2008).
Wolter, Lunderberg, Kang, and Herreid (2011) also investigated student perceptions of SRS in large undergraduate classes. The study explored student perceptions of using the clickers as well as what other factors, such as gender, influenced those perspectives. The study was conducted in nine different institutions across the United States and Canada with 12 different teachers. Students who participated in the study completed a 35 question, 5-point Likert scale survey at the end of the course which covered both demographic information as well as the student’s perceptions of the use of the clickers. A factor analysis and Varimax rotation of factors was completed to divide the 35 questions into five scales covering different topics related to the use of the clickers. The survey was completed by 1,457 students (933 female). Of these students, 1,097 were non-Science majors. A MANOVA was used to analyze the data from the survey data (Wolter et al., 2011).

Based on the results of the MANOVA, the study found that the overall perception of the use of clickers was neutral (M = 2.14, SD = 0.86). Gender did play a role in the perceptions of the use of the clickers ($F(3, 1,446) = 4.66, p < .01$). In this study, women had a more positive attitude towards using the clickers ($F(1, 1,446) = 6.58, p < .01$). However, based on the effect size, it was evident that gender did not explain all of this result since it only explained half of a percent of the variance. Another significant demographic was the type of major students were enrolled in (Science major vs. non-Science majors) ($F(1, 1,446) = 7.72, p < .001$). Students who were non-Science majors were more positive in their perceptions of the clickers than were the Science majors ($F(1, 1,446) = 15.36, p < .001$).
Effectiveness of Student Response Systems

Perhaps more important than student and teacher perspectives on the use of student response systems is whether the use of clickers is actually effective in the classroom. One study that explored whether clickers would increase student interest and performance was completed by Radosevich, Salomon, Radosevich, and Kahn (2008). The researchers decided to investigate the use of clickers in a behavior class at Montclair State University. One section of the class was taught with the use of clickers and another section of the same course was taught without these clickers. This quasi-experimental design study involved 145 participants in two comparable classes; seventy students were in the control group and seventy-five were in the clicker group. Both groups received the same lectures and presentations. However, the testing group was allowed to use the clickers throughout the presentation to answer multiple-choice questions about the lecture. The control group had access to these questions only after class to review. During week eight of the study, both groups took a midterm exam. For the next five weeks, the classes continued as before the study without the use of clickers. Finally, during the last week, the students completed a survey about their interest in the class and their prediction on whether they would have success on a follow-up retention test. Students were then given a final retention test that had the same items as the midterm. Researchers evaluated the data by comparing the means, standard deviations, and t values for both groups.

The results of this study revealed that the use of clickers was associated with higher test scores for the testing group over the control group. On the midterm exam,
students in the clicker group scored on average higher ($M = 82.72$) than the control group ($M = 78.83$). On the final retention test, taken six weeks after the midterm, the clicker group showed higher retention ($M = 48.47$) than the control group ($M = 34.86$). Not only did the clicker group score higher on assessments, they also had more interest in the class overall as revealed by a seven-point Likert scale ($M = 4.13$ compared to $M = 3.51$ for control group. Overall, the results supported existing research that student response systems can be an effective tool for feedback that enhances learning in the classroom (Radosovich et al., 2008).

There are often many confounding variables that impact educational research conducted classroom settings. Bartsch and Murphy (2011) chose therefore to conduct a laboratory study to test the effects of student response systems and control for confounding variables. The researchers wanted to investigate the effectiveness of using clickers compared to students raising their hands to participate in class. Researchers predicted that students’ engagement would be higher and academic performance would improve when using student response systems. The study involved 52 graduate students in psychology (39 female and 13 male) from a medium-sized state university. The average age of the participants was 29.9 years and half of the students were white, 29% Hispanic/Latino, 15% African American, and 6% other. The researchers offered a representative sample the opportunity to earn course credit or extra credit. In order to complete the research, students were randomly divided into two groups. Both groups received the same lecture and information on PowerPoint slides. However, the control group had seven yes/no
questions throughout the presentation in which they could raise their hand to answer. In the clicker group, students were able to answer the yes/no questions using the student response system available. After the lecture, both groups were first given a 5-point Likert survey to assess their engagement. Then, students received a quiz to assess their learning of the subject matter. The researchers used an ANOVA to analyze the data from the quizzes.

The results from the quizzes and surveys were significant. Students in the clicker group scored much higher than the control group ($M = 76\%$ compared to $M = 64\%$). There was also a positive relationship between engagement and the results of the assessments ($r(52) = .37$, $p=.007$). However, the amount of engagement between the two groups did not differ significantly; therefore, the researchers were unable to confirm their hypothesis about more engagement relating to the student response systems. An interesting note about the questions throughout the lecture was that these were mostly opinion oriented without right and wrong answers. Therefore, it is interesting that students did better on the final quiz after using the clickers since this would not have provided formative feedback to the student (Bartsch & Murphy, 2011).

Dallaire (2011) investigated the connection between the use of clickers, perception of clickers, and corresponding grades. The study involved 151 students enrolled in psychology and neuroscience courses (64% female). About mid-way through the semester, students were asked to voluntarily complete an online survey regarding the number of clicker uses, hindrances related to clickers, and perceived
benefits. Students were asked to submit their final grade at the end of the semester. The survey was adapted from a previously used survey and had an alpha coefficient of .83.

The results from the study revealed some informative details regarding the use of SRS in these classes. The main use of clickers reported by students was for teachers to take attendance (81%), the second most common use was to stimulate discussions (68%), followed by offering pretests, pop quizzes, or review sessions (67%), and, lastly, to determine retention and mastery (65%). Hindrances with the clickers included students reporting that they forgot to bring the clickers to class (57%) and equipment failure (24%). Students did feel that the clickers made the classes more engaging (53%). However, only 40% reported that the clickers were a very useful or an extremely useful tool (Dallaire, 2011). Students who reported more use of clickers perceived higher benefits from the devices ($r(150) = .399, p < .01$). In relation to clicker usage and grades, the study showed there was a difference ($F(6, 132) = 2.093, p = .06$). Students’ final grades improved when SRS were used, up to four uses, with a mean grade of 7.5 with only one use, but a mean grade of 10.6 for four uses. However, grades declined with more than four uses with a mean grade of 8.13 with seven uses ($F(2, 136) = 5.734, p < .01$) (Dallaire, 2011).

Edens (2006) also investigated the use of SRS in the classroom. However, this study differs in how the clickers were used. The research studied two different types of use of SRS, operant conditioning compared to metacognitive. Students in the operant conditioning group would have the results of their SRS use count as part of
their grade, whereas those in the metacognitive group would only use the SRS as a way of reflecting on their own learning without being graded. The researcher also wanted to discover how those different approaches would interact with gender, student level of self-regulation, and goal orientation. Lastly, it was desired to study whether anxiety, class preparation, and attendance were impacted by the use of SRS. The study involved 120 undergraduate students in a psychology class during the fall of 2006 (90 females, 30 male). The data included weekly quizzes using SRS, a post test exam, and a survey that was completed at the end of the course. In one section of the class, the operant conditioning approach was used with the SRS quizzes counting as 25% of the student’s grade. In the metacognitive approach, students were informed that the SRS was only used as a self-regulatory tool and would not count towards their grade. The first day of class included a pre-test to determine prior knowledge of the students. Nine different SRS quizzes consisting of ten multiple choice questions were used through the course. A final multiple choice test was administered as a post-test along with an online end of course survey. The researcher analyzed the results using MANOVA (Edens, 2006).

No difference was found based on approach when analyzing the exam results ($F(1, 119) = 1.318, p = .254$). However, the results showed some differences between the two different approaches using the SRS in relation to attendance and preparation for class ($F(1, 114) = 23.43 , p<.001$). First, students in the operant conditioning group (in which the SRS counted towards the final grade) were statistically
significantly more motivated not only to attend the classes, but also to prepare for the classes ahead of time. However, they were also more likely to experience anxiety in using the SRS ($F(1, 110) = 12.84, p < .01$). A partial Eta square result of 13.6 indicated that the effect size was minimal with only 13.6% of the overall variance explained by type of pedagogy. In regards to class preparation and attendance, 22% can be explained through type of pedagogy. Based on the analyses, it did not appear that the approach using the SRS mattered in relation to student achievement. There was a relationship between self-regulation and achievement ($F(1, 110) = 14.32$), with students more highly self-regulated in the metacognitive group scoring higher than those with low self-regulation skills ($F(1, 110) = 14.321, p < .001$). Survey results indicated that students who used the SRS as a metacognitive tool liked using them more than the other group, would be more likely to use them again, and also reported learning from their mistakes when using them (Edens, 2006).

Miller and Felson (2009) wanted to investigate if SRS could be effective in small as well as large classes. Since most of the previous research had been done in large lecture type courses, the researchers decided to create a study that would investigate the use of SRS in smaller class settings, which included 25 students or less. Ten different classes were studied across three semesters. Surveys were distributed that asked students about the effectiveness of SRS, including whether they increased their engagement and achievement in class. Instructors were also asked questions, including whether the clickers helped them in understanding their students’ needs. The survey contained 12 Likert scale questions. The results of these surveys
were compared to previous research results based on data from large classes. Of the 161 students in the courses, 125 completed the survey as well as nine instructors. All instructors used the clickers at least four times each semester, but could use them more if desired.

A majority of students (61%) and teachers (89%) believed that clickers were effective in enhancing their learning. In regards to the engagement that clickers may have increased, 71% of students agreed or strongly agreed that they were more engaged. All nine faculty members agreed or strongly agreed that clickers made students more engaged. A few of the items on the survey showed a statistical significance when compared to large class sizes. For example, the smaller classes ($M = 3.621, SD = 1.064, p < .05$) in this study actually reported a more positive opinion on the effectiveness of clickers in regards to increased learning when compared to large class sizes ($M = 4.070, SD = 0.828, p < .05$) (Miller & Felson, 2009).

**Summary**

Research has shown the importance and effectiveness of formative feedback throughout instruction (Brosvic et al., 2006; Dihoff et al., 2004; Peterson & Siadat, 2009). This feedback can increase student achievement on final summative assessments (Brosvic et al., 2006; Dihoff et al., 2004). Students and teachers are generally positive towards the use of clickers (Gok, 2011; Penuel et al., 2006). Some of the studies have indicated gender differences. Males tend to regard the use of clickers more positively than do females (Gok, 2011; Kay, 2009). Lastly, it appears that although clickers seem to consistently increase student engagement, it is not
clearly evident that they increase achievement (Bartsch & Murphy, 2011; Dallaire, 2011; Miller & Felson, 2009).

The next chapter explains the method of the study which seeks to explore the use of SRS in third grade classes at an elementary school. This chapter is followed by a chapter presenting the results of the study. Chapter V discusses the key findings and suggest recommendations for future research.
CHAPTER III

METHODOLOGY

This chapter presents the selection of participants, instrumentation, procedures and data analysis. The purpose of this study was to determine whether the use of student response systems during instruction would affect student learning as measured by chapter tests. This quantitative study included two third grade classes who completed pre and post-tests associated with two different math chapters. Students who used SRS were compared to those who did not use SRS after a week of instruction for each chapter. The method for this study received CSU Stanislaus Institutional Review Board approval, Protocol #1213-148, in March 2013.

Participants

The study sample included two third grade classes at a charter school that emphasizes the arts and technology within instruction. A convenience sample of 44 students participated, 27 boys and 17 girls. However, three to four students each week had missing data due to absences and these students were not included in the final analysis. The demographic characteristics of the classes were reflective of the school population. The charter school consisted of 421 students in K-8 grades and the school is considered high performing with an Academic Performance Index (API) score of 877. Demographic characteristics of the school were reflective of the larger community and included 48.5% white, 39.4% Hispanic, and 12.1% other. Less than 10% of the population was classified as English Learners and 52% qualified for the free and reduced lunch program (Education Data Partnership, 2013). In the sample,
six students were classified as English Learners and only one of these scored below level three on the California English Language Development Test (CELDT). The two third grade classes had different teachers, one who was the researcher for this study. During the two weeks of intervention and data collection, both classes were taught by the researcher.

A consent form was sent home to all students, which parents sent back signed only if they did not want their child’s data collected. There were no returned forms from students indicating a desire not to participate (see Appendix A).

**Procedures**

This study was completed over two non-consecutive weeks covering two different math chapters. Due to assessments planned previously, Chapter 30 was taught first and then Chapter 25. Chapter 30 covered decimals and fractions, while Chapter 25 covered metric measurement. Both classes had the opportunity to have one week of using clickers and one week of not using the clickers. The classes swapped teachers once per day so that the second class could be taught by the researcher. During each week of study, students received the same instruction in each chapter of math. On the first day of the week, students took a pre-test of the chapter, which was provided with the Harcourt curriculum. Then, both classes were taught by the researcher for four days of instruction.

The lessons were presented using the same PowerPoint in both classes. The slide show included the components of a “Direct Instruction” lesson. These presentations were created using the Harcourt curriculum for third grade Math. The
examples and steps used in the lessons were those provided in the Teacher’s Edition of the curriculum. The only difference between the two PowerPoint presentations was the addition of multiple choice questions to be used with the SRS for one of the classes each week. Each week, one class used the clickers throughout the lesson to answer periodic questions that provided feedback for students and the teacher whereas the other class did not use clickers, but did have whiteboards available to interact with throughout the lesson.

At the end of the week of instruction, both classes took a post-test of the math chapter also using a curriculum provided test. The curriculum provided two versions of each chapter test; one was multiple choice, the other was fill-in-the-blanks. One of these versions was used for the pre-test and the other was used for the post-test. Both tests included the same content in different wording and format (See Appendices B, C, D, E).

**Instrument**

The appropriate chapter tests from the Harcourt Math program for third grade were used to determine student achievement. Both the pre and post-tests were taken from this curriculum. For each chapter, the curriculum provided both a fill in the blanks and multiple choice test. One of these was used for the pretest, but only half of it (10 questions) was used due to time constraints. For the post-tests, students answered all 20 questions. The tests were graded using the key provided in the Teacher’s Edition of the textbook. Since these tests were taken from the curriculum, the teacher’s edition was searched for information on the reliability and validity of the
tests included in the program. No such information was available within the curriculum. The publisher and sales representative was also contacted to receive this information. However, because the curriculum was copyrighted in 2002, no data or research was available for this curriculum on the research that supports its use in the classroom.

**Data Analysis**

After the two week period was over, data was analyzed to determine whether there was a difference in academic performance between the group that used clickers and the group that did not. The data were also analyzed based on gender. Statistics Package for the Social Sciences (SPSS) version 20 was used to run an ANCOVA with the pre-tests as covariates. One analysis did not meet the equality of variance assumptions for an ANCOVA, and a one-way ANOVA was therefore used to test for significance using post-test scores only. Independent *t*-tests were used to analyze post-test differences based on gender. The independent variable for the study was the use or non-use of the clickers and the dependent variable was the results of the chapter tests. The pre-tests for each chapter were used as covariate when appropriate. An alpha level of .05 was used to determine statistical significance.

**Summary**

This study was conducted using a convenience sample consisting of two third grade classrooms a charter school located in the Central Valley of California. Both of the classes consisted of 22 students and had similar demographic characteristics.

Chapter tests were used to measure academic performance.
The next chapter presents the findings of the study. The last chapter includes a discussion of the findings, presentation of potential practical implications of the results, and suggestions for further research.
CHAPTER IV
RESULTS

This chapter presents the findings from this study. The study investigated two research questions: Whether the use of clickers would show an effect on academic performance, and if there were gender differences when it comes to the use of SRS in classroom instruction. Forty-four third grade students in two parallel classes participated in the study. Data were gathered in the form of pre and post-tests taken from the standard math curriculum used at the school.

Research Question 1

In order to investigate the difference between SRS use on academic performance, a one-way analysis of covariance (ANCOVA) was completed for each week of the study which covered two different math chapters. First, an ANCOVA was run for the first week, which covered Chapter 30 relating to decimals and fractions. The independent variable was the use of SRS by class. The dependent variable was the chapter test. The covariate was the results of the students’ pre-test scores. However, after completing the ANCOVA analysis, Levene’s Test of Equality showed that equal variances could not be assumed ($F(1, 38) = 12.04, p < .01$). Therefore, since this analysis was inappropriate, a one-way analysis of variance was completed using the post-test scores. The independent variable was the use of clickers, while the dependent variable was the results of the posttest. The ANOVA was not significant for Chapter 30 ($F(1, 38) = .49, p = .49$) and the means of the two
classes were very similar (see Table 1). Class 1 that used the SRS had a mean score of 14.10 and the Class 2 that did not use the SRS had a mean score of 15.10.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1 (SRS)</td>
<td>20</td>
<td>14.10</td>
<td>5.33</td>
<td>0.485</td>
<td>0.49</td>
</tr>
<tr>
<td>Class 2</td>
<td>20</td>
<td>15.10</td>
<td>3.58</td>
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</tbody>
</table>

A one-way analysis of covariance (ANCOVA) was conducted to analyze the results of the second chapter, Chapter 25, which covered metric measurement. The independent variable, dependent variable, and covariate remained the same as the previous ANCOVA. Levene’s Test of Equality of Error Variances indicated that the homogeneity of slopes was not significantly different ($F(1, 39) = 0.255$, $p = 0.62$). The resulting ANCOVA was not significant ($F(1, 38) = 2.98$, $p = 0.09$) (see Table 2). The adjusted means did not show a significant difference between the two classes. Class 1 that did not use SRS had a mean score of 17.98 and Class 2 that used the SRS had a slightly lower mean score of 16.62.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>$M^{adj}$</th>
<th>SD</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>21</td>
<td>17.98</td>
<td>0.53</td>
<td>2.98</td>
<td>0.09</td>
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<tr>
<td>Class 2 (with SRS)</td>
<td>20</td>
<td>16.62</td>
<td>0.54</td>
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</tr>
</tbody>
</table>

Since no statistically significant differences were found between classes in relation to clicker use, a follow up analysis was performed to identify if there was a difference in mean improvement from pre to post-test between the two classes. An
independent $t$-test was completed to determine whether there was a difference in mean improvement on Chapter 30 from the pre to post test. The differences between the classes was not significant ($t(38) = -0.973, p = .34$). Students who used the SRS ($M = 7.70, SD = 5.07$) did not have a significantly different average score than those who did not use the SRS ($M = 8.95, SD = 2.70$) (see Table 3). On Chapter 25, there was a significant difference between the two classes when looking at improvement ($t(39) = 2.67, p = .01$). During this week, students who used the SRS from Class 2 ($M = 8.60, SD = 2.87$) showed less improvement than those who did not use SRS in Class 1 ($M = 10.67, SD = 2.03$).

Table 3

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<thead>
<tr>
<th></th>
<th>n</th>
<th>$M$</th>
<th>$SD$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
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<td>Chapter 30</td>
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<td></td>
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<tr>
<td>Class 1 (SRS)</td>
<td>20</td>
<td>7.70</td>
<td>5.07</td>
<td>-0.973</td>
<td>.339</td>
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<tr>
<td>Class 2</td>
<td>20</td>
<td>8.95</td>
<td>2.70</td>
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<td></td>
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<td>Chapter 25</td>
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<td></td>
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<tr>
<td>Class 1</td>
<td>21</td>
<td>10.67</td>
<td>2.03</td>
<td>2.67</td>
<td>.01*</td>
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<tr>
<td>Class 2 (SRS)</td>
<td>20</td>
<td>8.60</td>
<td>2.87</td>
<td></td>
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</tbody>
</table>

*p < .05

Research Question 2

In order to investigate differences based on gender in relation to clicker use, an independent samples $t$-test was conducted for each week of instruction (see Table 4). For Chapter 30, the result of the $t$-test was not significant for males ($t(22) = .474, p = .64$) or females ($t(14) = -1.37, p = .19$). Males that used SRS had a mean score of 15.45 ($SD = 4.20$) compared to the mean score of males that did not use SRS of 12.44 ($SD = 6.31$). Females that used SRS ($M = 14.69, SD = 3.68$) had a slightly lower mean score than those who did not use SRS ($M = 15.86, SD = 3.53$). Chapter 25 tests
did not yield any statistically significant difference when looking at males ($t(22) = 1.11, p = .28$) or females ($t(15) = .745, p = .47$). Males in Class 1 who did not use SRS ($M = 17.91, SD = 1.92$) had a very similar mean score to males in Class 2 who used SRS ($M = 17.70, SD = 2.41$). Females in Class 2 who used SRS ($M = 16.86, SD = 2.12$) also had a similar mean score to females who did not use SRS ($M = 16.77, SD = 2.89$).

Table 4

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$t$</td>
<td>$p$</td>
</tr>
<tr>
<td>Chapter 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 1 (SRS)</td>
<td>Male</td>
<td>11</td>
<td>15.45</td>
<td>.47</td>
<td>.64</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>13</td>
<td>14.69</td>
<td>3.68</td>
<td></td>
</tr>
<tr>
<td>Class 2</td>
<td>Male</td>
<td>9</td>
<td>12.44</td>
<td>-1.28</td>
<td>.22</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>7</td>
<td>15.86</td>
<td>3.53</td>
<td></td>
</tr>
<tr>
<td>Chapter 25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 1</td>
<td>Male</td>
<td>11</td>
<td>19.91</td>
<td>1.11</td>
<td>.28</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>13</td>
<td>16.77</td>
<td>2.89</td>
<td></td>
</tr>
<tr>
<td>Class 2 (SRS)</td>
<td>Male</td>
<td>10</td>
<td>17.70</td>
<td>.745</td>
<td>.47</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>7</td>
<td>16.86</td>
<td>2.12</td>
<td></td>
</tr>
</tbody>
</table>

Since significant difference was found in the difference of improvement from pre to posttest on Chapter 25 (see Table 3), a follow up analysis was performed to compare based on gender in relation to improvement from pre to posttest. For Chapter 30, there was no significant difference between males ($t(22) = .401, p = .69$) or females in relation to SRS use as related to improvement ($t(14) = -1.85, p = .09$). The difference in improvement for males in Class 1 that did use SRS ($M = 9.45, SD = 4.41$) was a little higher than those that did not use SRS ($M = 5.56, SD = 5.22$), but not significant. The mean improvement results for females that used SRS ($M = 8.85,$
SD = 3.00) was similar to females that did not use the technology (M = 9.14, SD = 2.27) (see Table 5). Chapter 25, which showed a significant difference when looking at mean improvement scores for the two classes, also showed a significant difference when gender was included. However, it was only for males that this significant difference existed (t(22) = 2.60, p = .02). There was no statistically significant difference for females and improvement (t(15) = .936, p = .36). Females that did not use SRS in Class 1 had a mean score of 8.23 (SD = 3.00), while females that used SRS from Class 2 had a mean score of 9.29 (SD = 2.69). Males that did not use SRS in class 1 (M = 10.82, SD = 1.47) had a slightly higher mean score improvement than males that used SRS (M = 10.50, SD = 2.59).

Table 5

<table>
<thead>
<tr>
<th></th>
<th>Chapter 30</th>
<th></th>
<th>Chapter 25</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Class 1 (SRS)</td>
<td>Males</td>
<td>Class 1 (SRS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class 2</td>
<td></td>
<td>Class 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 11, M = 9.45, SD = 4.41</td>
<td>Class 1</td>
<td>Class 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 9, M = 5.56, SD = 5.22</td>
<td>Class 2</td>
<td>Class 2</td>
</tr>
<tr>
<td>Females</td>
<td>Class 1 (SRS)</td>
<td>n = 13, M = 8.85, SD = 3.00</td>
<td>Class 2</td>
<td>Class 2</td>
</tr>
<tr>
<td></td>
<td>Class 1</td>
<td>n = 13, M = 8.23, SD = 3.00</td>
<td>Class 2</td>
<td>Class 2</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>n = 7, M = 9.14, SD = 2.27</td>
<td>Class 2</td>
<td>Class 2</td>
</tr>
<tr>
<td>Class 2</td>
<td>Class 1</td>
<td>n = 10, M = 10.50, SD = 2.59</td>
<td>Class 2</td>
<td>Class 2</td>
</tr>
<tr>
<td>Females</td>
<td>Class 1</td>
<td>n = 13, M = 8.23, SD = 3.00</td>
<td>Class 2</td>
<td>Class 2</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>n = 7, M = 9.29, SD = 2.69</td>
<td>Class 2</td>
<td>Class 2</td>
</tr>
</tbody>
</table>

* p < .05

Summary

The data collected from two third grade classes showed non-significant findings in relation to both research questions. The use of SRS did not seem to impact
summative assessment results. The only significant difference was on the mean improvement from pre to post-test on Chapter 25. In this chapter, boys who did not use clickers improved slightly more than boys who used clickers. In the next chapter, these findings will be discussed followed by recommendations for further research.
CHAPTER V

DISCUSSION AND RECOMMENDATIONS

This study investigated whether the use of clickers would affect academic performance in two third grade classrooms as measured by chapter tests. Further, the study aimed at investigating if there were gender differences when it came to using SRS.

This chapter will first summarize and discuss the findings of the study. Finally, conclusions and recommendations for further research will be provided.

Discussion

Research Question #1

The data in this study did not support that there were differences on students’ summative assessment scores after they had received instruction either using or not using SRS. The data did show, however, that the students who received instruction not using SRS significantly improved from pre to post measure on the second Chapter (25) test. All remaining analyses indicated that there was no difference between pre and post scores for the two classes.

These results are in contrast to previous research that have concluded that students who receive frequent formative feedback often tend to do better on summative assessments (Brosvic et al., 2006; Dihoff et al., 2004; Peterson & Siadat, 2009). Some of this research has shown specifically that immediate feedback can also cause an increase in achievement scores (Dihoff et al., 2004). Further, other researchers have identified a positive relationship between clicker use and
achievement (Bartsch & Murphy, 2011; Dallaire, 2011; Rosovich et al., 2008). These conclusions were not without dissent. Dallaire (2011) concluded that, although there is a positive educational impact of students’ use of SRS, it was found that the more students used the technology (more than seven times), the scores actually started to decrease. It should be noted that all of these studies were completed in university level courses and, as a result, may be difficult to compare to a study investigating third graders.

There are several factors that might have contributed to the lack of statistical findings in this research. First of all, a very small sample was used for this study \( n = 41 \). Also, the length of time in which the study was completed was short, lasting only two weeks, and measures were limited to chapter tests covering two chapters in the textbook. This is a very limited snapshot of how students perform on a given topic and it is possible that some mathematical concepts and problems are better supported by the use of SRS than others.

A possible reason that could explain the lack of effect of the use of SRS as a tool for immediate feedback is the use of whiteboards (each student has their own on the desk) in the non-SRS group. The students who did not use clickers still interacted with the lesson content using whiteboards, which still allowed the researcher to change instruction based on student needs and provide oral feedback to students as necessary based on whiteboard results. Perhaps the difference between the use of whiteboards and clickers in regards to feedback was not enough to show a difference in results. In fact, since one measure showed that students demonstrated more
improvement when not using SRS, it may indicate that whiteboards were more effective for this particular chapter. Whiteboards often facilitate more open ended answers than remotes and, therefore, may involve more critical thinking and aid in memory recall.

However, the difference in improvement between the two classes could also be explained by the nature of the students and characteristics of the teacher. Since the students in the two classes normally were taught by different teachers, they came to the intervention with different background knowledge and previously taught concepts. One class could have had more prior knowledge of measurement concepts covered in Chapter 25 than the other class, thus explaining the significant difference from pre to post test.

**Research Question #2**

The second research question investigated possible gender differences when it comes to using SRS while teaching third grade mathematics. The research did not identify any overall differences based on gender with one exception, for the Chapter 25 tests, there was a significant difference in improvement between the boys in the two classes. The boys who did not use SRS showed more improvement than those who did use SRS. This would indicate that the clickers did not increase achievement among boys.

Much of the research regarding gender and SRS is related to the perception of students more so than their achievement results. Since this study did not involve collecting data on student perceptions, it is difficult to compare the research to this
study in relation to gender. However, the results of this study do seem to be somewhat contrary to the existing research. Gok (2011) and Kay (2009) reported in their studies that boys tend to have more positive attitudes towards the use of SRS as compared to girls. Boys reported feeling more engaged in the lesson and indicated that this helped with their learning. Girls, on the other hand, frequently reported feelings of anxiety related to using SRS. In this study, there was a small difference when looking at improvement from pre to post test for males. Interestingly enough, it was the boys who did not use clickers that improved more, which does seem to contradict the literature.

The results related to gender can possibly be explained by the small sample size that made it difficult to identify differences that were statistically significant. Also, it is unknown in this study what the students’ perceptions of the SRS were. It is possible that boys could have felt more engaged even if that were not part of what was measured. The researcher made every effort to make the lessons equal in every way except the use of the clicker, but it may be that there was not enough of a difference in the lessons to detect any variations based on gender. For the boys who showed more improvement when not using clickers, it could be that the use of the whiteboards allowed for more critical thinking rather than a predefined multiple choice answer which are to typical when using clickers. Students can also more easily discuss their answers together when looking at whiteboards compared to clickers. These factors could have helped the boys to show more improvement from pre to post test for one of the chapters when not using clickers.
Conclusions

The results of this study are inconclusive. It is not evident whether SRS are a more effective tool for feedback compared to other devices such as individual whiteboards. However, since the classes had similar results, it can be concluded that whiteboards and clickers may provide similar feedback to students in order to improve their learning. Both tools allowed the researcher to gauge student learning and adjust instruction as needed.

During the weeks of instruction, the researcher perceived that the clickers provided timely and useful feedback from the students. The researcher was able to see clearly when students overall were struggling with the concepts when using the SRS. On the other hand, the use of whiteboard also provided this type of information based on the information the teacher was able to scan while moving around in the classroom. Although the feedback received through the use of SRS was immediate and thus allowed for quick adjustment to the instruction, it was clearly not enough to make a difference in academic achievement as measured by the two chapter tests.

Recommendations

The use of SRS in elementary school settings are increasing rapidly. At the same time, very few studies have focused on this age group. The current study had a very small sample size, it would be important to complete studies with a larger sample size and an intervention that had a longer duration and covered a variety of topics. Since this study lasted only two weeks, over two different chapters in Math, potential differences might have been identified if that timeline was extended to cover
more chapters. Another content area could also be researched; perhaps Science or Social Studies would yield different results. It may also be helpful to include several grades in order to increase the number of participants and be able to compare across grade levels.

The study might also benefit from being completed in a different school with more diverse demographics than the setting in which this study took place. This school is high performing academically and it could be that there was not enough variability among students to show much improvement or differences on the tests. Another possibility is to take away all possibility for feedback from the class that does not use clickers. Instead of the non-SRS class using whiteboards, they would not have any way to provide feedback to the teacher or receive feedback. This would present results that are more related to feedback in general and whether or not clickers can provide much need information that can help teachers guide their instruction to the needs of the students.

Regardless of the lack of results from this study to show the whether SRS can be an effective tool for feedback in the classroom; teachers should still seek out best practices for providing timely feedback to students. When students receive feedback, they can reflect on their learning and make adjustments, as can the teacher. Therefore, it is imperative that teachers seek to collect information from students and provide feedback in some way whether using technology or not.
REFERENCES
REFERENCES


Edens, K. M. (2006). The interaction of pedagogical approach, gender, self-
regulation, and goal orientation using student response system technology.


response systems to increase motivation, learning, and knowledge retention.


APPENDIX A

INFORMED CONSENT

Dear Participant:

You are being asked to allow your child to participate in a research project that is being done to fulfill requirements for a Master’s degree in Elementary Curriculum and Instruction at CSU Stanislaus. We hope to learn whether the use of student response systems (often referred to as “clickers”) increase student achievement on summative assessments. If you decide to allow your child to participate, your child will be asked to participate in two weeks of math instruction presented by Mrs. Crawford to both third grade classes at different times during the day. Each week, one class will use the clickers, while the other class will not use the clickers. The next week will alternate which class uses the clickers. Students will take both a pre and post test to determine whether the use of clickers had any relationship with student performance on the final weekly test.

Alternatives to participating in the study include participating in the daily lessons without having any data assessed for this project.

There are no known risks to you for your child’s participation in this study.

It is possible that your child will not benefit directly by participating in this study. The information collected will be protected from all inappropriate disclosure under the law. All data will be kept in a secure location. Individual subject data will only be accessible to the third grade teachers at Whitmore Charter School. Beyond that, all subjects will be assigned anonymous ID numbers so the individual’s information remains private.

There is no cost to you or your child beyond the time and effort required to complete the procedure(s) described above. Your child’s participation is voluntary. Refusal to participate in this study will involve no penalty or loss of benefits. You may withdraw your child at any time without penalty or loss of benefits.

If you do not wish your child to participate in having your child’s data collected, please indicate this decision by signing below. If you have any questions about this research project please contact me, Amanda Crawford, at (XXX) XXX-XXXX or _________@______.com, or my faculty sponsor, Dr. Oddmund Myhre at (XXX) XXX-XXXX. If you have any questions regarding your rights and participation as a research subject, please contact the Campus Compliance Officer by phone (XXX) XXX-XXXX or email IRBAdmin@csustan.edu.
Sincerely,
Amanda Crawford
Third Grade Teacher

_____ I do not wish for data to be collected on my child.

____________________________________              ______________________
Parent Signature       Date
APPENDIX B

CHAPTER 25 PRE-TEST

Write the correct answer.

1. Which unit would be used to measure the amount of water in a small glass? Write mL or L.

2. Circle the object with the greater mass.
   apple    watermelon

3. Measure the pencil to the nearest centimeter.
   __________ cm

4. Write the temperature shown on the thermometer.
   __________ °F

5. Measure the string to the nearest centimeter.
   __________ cm

6. Which unit would be used to measure the mass of a desk? Write g or kg.

7. Circle the better estimate for the amount of water it would take to fill a kitchen sink.
   10 mL    10 L

8. Write the temperature shown on the thermometer.
   __________ °C

9. Which unit would be used to measure the distance a train travels in 2 hours? Write m or km.

10. Circle the correct answer.
    __________ is the amount a container can hold.

    Length   Capacity   Weight
    __________  __________  __________

    Assessment Guide   AG 163
APPENDIX C

CHAPTER 25 POST-TEST

Choose the best answer.

1. Which unit would be used to measure the amount of apple juice in a cup?
   A km   C mL
   B m    D L

2. Which object has the greatest mass?
   F a grape
   G a basket of apples
   H a box of cereal
   J a sofa

3. Measure the pencil to the nearest centimeter.
   A 2 cm   C 4 cm
   B 3 cm   D 5 cm

4. What temperature does the thermometer show?
   F 40°F
   G 45°F
   H 50°F
   J 55°F

5. Measure the string to the nearest centimeter.
   A 2 cm   C 4 cm
   B 3 cm   D 5 cm

6. Which unit would be used to measure the mass of a bicycle?
   F kg
   G L
   H g
   J mL

7. Which is the best estimate for the amount of gasoline a gas tank in a car can hold?
   A 45 m
   B 45 km
   C 45 L
   D 45 mL

8. What temperature does the thermometer show?
   F 15°C
   G 20°C
   H 25°C
   J 30°C

9. Which unit would be used to measure the distance from one city to another city?
   A cm   C m
   B dm   D km
10. Which best describes capacity?
   F the length of a container
   G the amount a container holds
   H the distance a container moves
   J the temperature of a container

11. Which activity is likely to be done outside when the temperature is 30°C?
   A snow skiing
   B ice-skating
   C roller-skating
   D making snowballs

12. Compare the amounts.
   1 g < 1 kg

13. Which unit would be best to measure the length of a playground?
   A cm
   B dm
   C m
   D km

14. Which container holds more than 5 liters?
   F a water pitcher
   G a tea cup
   H a medicine dropper
   J a bathtub

15. Which object has a greater mass than an orange?
   A a paper clip
   B a chair
   C a pencil
   D a sheet of paper

16. Which table helps to find how many centimeters there are in 4 meters?
   F Table 1
   G Table 2
   H Table 3
   J Table 4

17. How many centimeters are in 3 meters?
   A 3
   B 300
   C 1,000
   D 3,000

18. Which table helps to find how many meters there are in 2 kilometers?
   F Table 1
   G Table 2
   H Table 3
   J Table 4

19. How many meters are in 4 kilometers?
   A 4
   B 40
   C 400
   D 4,000

20. What might the temperature be if people need to wear winter coats, hats, and gloves?
   F 20°F
   G 75°F
   H 80°F
   J 85°F
### APPENDIX D

### CHAPTER 30 PRE-TEST

#### Name

| 11. Marita has $\frac{1}{10}$ of a dollar. How much money is this? |
|---|---|
| A $0.01$ | C $0.25$ |
| B $0.10$ | D $0.50$ |

<table>
<thead>
<tr>
<th>12. $0.57$</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ $0.39$</td>
</tr>
<tr>
<td>$F$ $0.96$</td>
</tr>
<tr>
<td>$G$ $0.89$</td>
</tr>
<tr>
<td>$H$ $0.86$</td>
</tr>
<tr>
<td>$J$ $0.22$</td>
</tr>
</tbody>
</table>

| 16. What amount of money is $\frac{4}{100}$ of a dollar? |
|---|---|
| F $40$ | H $0.40$ |
| G $4$ | J $0.04$ |

<table>
<thead>
<tr>
<th>17. $0.90$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-0.26$</td>
</tr>
<tr>
<td>A $0.76$</td>
</tr>
<tr>
<td>B $0.74$</td>
</tr>
<tr>
<td>C $0.64$</td>
</tr>
<tr>
<td>D $0.54$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13. Find the missing numbers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.38 = \square$ dimes $\square$ pennies</td>
</tr>
<tr>
<td>A $3, 8$</td>
</tr>
<tr>
<td>B $38, 0$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14. Mr. Dyer's yard is $0.25$ acre and Mr. Bartley's is $0.33$ acre. How much land do they have in all?</th>
</tr>
</thead>
<tbody>
<tr>
<td>F $0.95$ acre</td>
</tr>
<tr>
<td>G $0.58$ acre</td>
</tr>
<tr>
<td>H $0.23$ acre</td>
</tr>
<tr>
<td>J $0.08$ acre</td>
</tr>
</tbody>
</table>

| 18. One bagel costs $0.43$ and one roll costs $0.36$. Ron buys $3$ bagels and $2$ rolls. How much change should he get back from $\$3$? |
|---|---|
| F $2.21$ | H $0.79$ |
| G $0.99$ | J $0.06$ |

<table>
<thead>
<tr>
<th>19. What fraction of a dollar is shown?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A $\frac{1}{5}$</td>
</tr>
<tr>
<td>B $\frac{1}{4}$</td>
</tr>
</tbody>
</table>

| 20. What amount of money is $\frac{89}{100}$ of a dollar? |
|---|---|
| F $89$ | H $8.09$ |
| G $8.90$ | J $0.89$ |
APPENDIX E

CHAPTER 30 POST-TEST

Write the correct answer.

1. A can of peas costs $0.39 and a can of corn costs $0.49. How much would it cost to buy one of each?

2. What fraction of a dollar is shown?

3. Cassie buys 2 apples for $0.35 each and a pint of milk for $0.89. How much change should she get back from $5?

4. $0.47 + $0.34

5. Mac found $0.45 in his coin bank on Monday. He earned $0.50 on Tuesday. He spent $0.58 on Friday. How much money does he have left?

6. Write the amount of money as a fraction of a dollar.

7. $0.74
   \[ - \] $0.56

8. What amount of money is 32 hundredths of a dollar?

9. Greg has $0.81 and Dennis has $0.45. How much more money does Greg have than Dennis?

10. BANANAS $0.39 PER POUND
     PINEAPPLES $0.79 EACH

     Cassie buys 2 pounds of bananas and 1 pineapple. How much change should she get back from $5?
11. Todd has \( \frac{3}{4} \) of a dollar. How much money is this?

12. \[
\begin{array}{c}
0.36 \\
+ 0.15 \\
\hline
\end{array}
\]

13. Write the missing numbers.

\[
0.27 = \underline{\quad} \text{ dimes} \underline{\quad} \text{ pennies}
\]

14. The Owens' backyard is 0.35 acre and the Fords' backyard is 0.59 acre. How many acres is that in all?

\[
\underline{\quad} \text{ acre}
\]

15. What fraction of a dollar is shown?

\[
\begin{array}{c}
\text{penny} \\
\text{nickel} \\
\text{dime} \\
\text{quarter}
\end{array}
\]

\[
\underline{\quad} \text{ of a dollar}
\]

16. What amount of money is \( \frac{6}{100} \) of a dollar?

17. \[
\begin{array}{c}
0.70 \\
- 0.18 \\
\hline
\end{array}
\]

18. A pint of orange juice costs \$0.79 and a muffin costs \$0.35. Janice buys 2 pints of orange juice and 2 muffins. How much change should she get back from \$3?

19. Write the amount of money as a fraction of a dollar.

\[
\begin{array}{c}
\text{penny} \\
\text{nickel} \\
\text{dime} \\
\text{quarter}
\end{array}
\]

\[
\underline{\quad} \text{ of a dollar}
\]

20. What amount of money is \( \frac{54}{100} \) of a dollar?