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An Evaluation of an Electronic Student Response System in Improving Class-wide Behavior

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An Evaluation of an Electronic Student Response System in Improving Class-wide Behavior

by

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Abstract

A student response system is a technology that allows an entire classroom of students to respond to questions and receive immediate feedback from teachers during instruction. However, little research has examined the use of student response systems to support student behavior in elementary schools. This study focused on using an electronic student response system to improve class-wide behavior in two general elementary school classrooms. An ABAB and ABA reversal designs embedded within a multiple baseline design across classrooms was employed to evaluate the outcome of the intervention. Although limited, the results indicated that the classroom teachers implemented the electronic student response system with fidelity, and their implementation of the intervention resulted in reduced disruption and increased academic engagement. Social validity data indicated that the electronic response system intervention was acceptable to both teachers and students to some degree.

Chapter 1:

Introduction

Teachers face many obstacles in their classroom each day. One issue that teachers face is keeping students on-task or engaged during class instruction (Bru, 2009). When students are not engaged in the instruction, they tend to engage in other behaviors that can be distracting to other students in the classroom. These off-task behaviors can lead to class disruption, which affects teacher instructional time and student learning (Bru, 2009). A national survey of teachers reported that 77% of teachers believed their classes would run more effectively if they spent less time dealing with disruptive behaviors (Public Agenda, 2004). Academic engagement is important for students to learn during instruction periods. Teacher accountability for student outcomes is an important part of teacher evaluations (Harris, Ingle, & Rutledge, 2014). In order to address the issue of disruptive behavior, it is imperative to promote appropriate behavior in the classroom for the future benefit of all students (Horner & Sugai, 2000).

Positive behavioral interventions and supports (PBIS) is an evidence-based practice that is used in schools to support children's social, behavioral, and academic development (Bradshaw, Waasdorp, & Leaf, 2012; Dunlap, Kincaid, Horner, Knoster, & Bradshaw, 2014; Pas & Bradshaw, 2012). The PBIS framework is set up as a three-tiered system of support for managing students' challenging behavior. The framework assists schools in defining school-wide expectations and rules that are specific to the school's individual needs and goals. The first tier

of the model is a school-wide approach that focuses on the support of all students in the school, teaching the expectations and rules to the students in order for the students to know exactly what is expected of them (Horner et al., 2014). The second and third tiers of the model focus on a smaller portion of the student body. These tiers are for children who require more supports than Tier 1 allows. Tier 3 supports utilize functional behavior assessments and behavior intervention plans for students who require intensive individualized interventions (Horner et al., 2014).

Although some students require Tier 3 interventions, Tier 1 and Tier 2 interventions have shown to be effective in reducing the majority of students' problem behaviors within a school or classroom (Flannery, Fenning, Kato, & McIntosh, 2014; Swoszowski, McDaniel, Jolivette, & Melius, 2013). Class-wide interventions within the school-wide PBIS are a Tier 1 support that can be effective in decreasing problem behaviors of students in the classroom (Kraemer, Davies, Arndt, & Hunley, 2012). Class-wide interventions, such as response cards (Cavanaugh, Heward, & Donelson, 1996; Wood, Mabry, Kretlow, Lo, & Galloway, 2009), choral responding (Godfrey, Grisham-Brown, & Schuster, 2003), and guided notes (Larwin, Dawson, Erickson, & Larwin, 2012; Sweeney et al., 1999) provide students with high rates of opportunities to respond actively, thereby, reducing disruption during instructional time and improving student behavior (Blackwell & McLaughlin, 2005).

For example, studies have found that response cards increase student academic engagement (Christle & Schuster, 2003; Marmolejo, Wilder, & Bradley, 2004; Wood et al., 2009) and decrease disruptive and off-task behaviors (Armendariz & Umbreit, 1999; Gardner, Heward, & Grossi, 1994). Response cards allow each student to respond to a teacher's question at the same time as other students while allowing teachers to get a quick glimpse at how many students in the class understand the material (Marmolejo et al., 2004) and make instructional

adjustments as needed. Flashcards or white boards are often used as response cards (Duchaine, Green, & Jolivette, 2010; Gardner et al., 1994).

One class-wide approach to increasing active student responding are student response systems, an electronic tool that documents prompted responses given by the individual students and have primarily been used in college classrooms (Kay & Knaack, 2009). Student response systems are used for many different reasons; these can include monitoring attendance in the class, collecting grades, and monitoring the class's responses to questions on the material during lectures (Fies & Marshall, 2008). One difference between response cards and student response systems is that student response systems allow the teacher and the class to see a graphed representation of the class's response to each question on the screen (Kay & LeSage, 2009).

Student response systems allow students to respond to questions presented through the use of a handheld electronic response device (Kay & LeSage, 2009). These electronic student response systems have many different names, such as audience response system, personal response system, electronic response system, electronic voting system, classroom communication system, and clickers (Clauson, Alkhateeb, & Singh-Franco, 2012; Collins, 2007; Jones, Antonenkot, & Greenwood, 2012; Schmid, 2008; Shaffer & Collura, 2009). The student response systems can include multiple choice and true or false functions (Blood, 2010; Vana, Silva, Muzyka, & Hirani, 2011). The information provided by the students is transmitted to the teacher's computer and is displayed in a graphical format based on the percentage of student responses to a question (Collins, 2007). This class-wide student response system is different from the traditional use of hand raising for responding during instruction because the response system technology allows every student to respond to questions posted by the teacher at the same time via a remote handheld device, commonly referred to as a "clicker" (Jones et al., 2012). The

technology also allows the teacher to record the students' responses using the software and broadcast the results to the class using a multi-media projection device.

A growing body of research on electronic student response systems has provided evidence for increased academic achievement (Kaleta, Skibba, & Joosten, 2007), engagement of non-participatory students (Salamonson, Andrew, & Everett, 2009), and correct responding (Kulesza, Clawson, & Ridgway, 2014). However, studies on the use of student response systems have found mixed results for social validity and student engagement. In general, studies have reported positive student outcomes and high levels of social validity of the intervention when assessed with teachers (Grimes, Rogers, Volker, & Ramberg, 2010). For example, Stowell and Nelson (2007) examined the impact of different response forms on student engagement in a higher education setting and found that the student response system resulted in the highest rate of responding compared to general hand raising, multiple choice hand raising, and response cards. Medina et al. (2008) also examined the use of a student response system in a higher education setting and found that students and teachers reported an increase in class discussions. Szwed and Bouck (2013) used an electronic student response system as a self-monitoring tool for three students with disabilities and at-risk for behavioral disorders in an inclusive second grade classroom. During intervention, the students recorded if they were on or off task every 5 minutes during the 50-minute instructional time using the response system. The results indicated that the use of the student response system decreased the students' off-task behavior. Additionally, the students and teachers reported positive results about the use of the electronic student response system as a self-monitoring tool.

One possible reason for the positive results is that the electronic student response system allows students to anonymously respond to the teacher's question without the worry of social

stigma or retribution (Fallon & Forrest, 2011). When a student responds to a question using the handheld device, their answer is polled with the rest of the classroom responses and a graph is displayed showing the total of each response from the class. This method eliminates the individual vocal response of the student from raising their hand or the potential for others to look at their answer using response cards. Teachers have the flexibility to use student response systems in many different ways that best fit with their classroom structure.

However, Mayer et al. (2009) suggested that the electronic student response systems alone did not increase academic achievement, but rather the utilization of a class-wide response system increased opportunities for teachers to engage students in instructional activities using interactive questions, which, in turn, are related to increased academic achievement. Moreover, a few studies reported negative results for using student response systems with high school and college students (Kay & Knaack, 2009; Vana et al., 2011). For example, Kay and Knaack (2009) indicated that some students reported feeling stressed when they used a clicker during tests, and teachers commented that technical difficulties with the student response system occurred. In addition, in a study with college students, Tregonning, Doherty, Hornbuckle, and Dickinson (2012) found that increased quiz scores were not maintained when clickers were not used at 5-week follow up.

Thus, these mixed results from the use of electronic student response systems in the classroom and the limited research on response systems in elementary schools warrant the need for further research. Therefore, the purpose of this study was to examine the impact of an electronic student response system during class instruction on class-wide disruptive behavior, academic engagement, and quiz performance in elementary general education classrooms. The study addressed the following questions:

1. To what extent can teachers implement the electronic student response system procedures with fidelity during instructional time periods?
2. To what extent will the use of the electronic student response system decrease class-wide disruptive behavior and increase academic engagement?
3. Will the use of the response system positively impact quiz performance?
4. Will teachers and students find the use of the response system to be favorable?

Chapter 2:

Method

Setting

This study was conducted in two general education classrooms of an elementary school (Pre-K through 5th) in a rural town. The school is a Title 1 school with approximately 600 multi-ethnic students, 87.6% on free or reduced price lunch. As of 2014, the student demographics include 59.3% Hispanic, 3.5% Black, 34.1% White, 1.3% Asian, 0.2% American Indian or Alaskan Native, and 1.7% Multi-Racial. This school has implemented PBIS for 3 years, as of the (2013-2014) school year. The school scored an 87.9% on their most recent Benchmarks of Quality (BOQ; Childs, Kincaid, & George, 2010). Based on the BOQ score, the school is considered a high integrity implementer of the PBIS program.

Participants

The participants in this study included teachers and students in two first and second grade general education classrooms. Teachers completed an informed consent form to be included in the study. All students verbally assented to participate in the study if they were 7-9 years old. Participants received information detailing the components of the study. Classrooms were selected based on the following criteria: a) teacher request for support with classroom management difficulties; b) at least 20% of students engaged in disruptive behavior; c) teacher completed the informed consent form; d) at least 80% of students' parents completed informed

consent forms, and d) students assented to participate in the study. Exclusion criteria were Pre-K-K grade classrooms and classrooms that were using other electronic student response systems or used the clickers in the past; and classrooms in which the teacher did not know how to use PowerPoint and was unwilling to learn how to use it.

Classroom 1 was a second grade classroom with 15 students. The targeted intervention period was math and lasted between 30 minutes to an hour. Math instruction consisted of whole group instruction, small group instruction, individual work, and group work. The students in the study were 83.3% Hispanic and 16.7% White. Fifty-eight percent of the students in the study were English Language Learners (ELL). The students were 50% females and 50% males and 83.3% of the class qualified for free or reduced lunch. Teacher 1 was a white, non-Hispanic female in her 20's and in her first year of teaching, who took over the classroom in December. The teacher has a master's degree in Special Education with a reading endorsement and ESOL. Teacher 1 used a color clip chart as a classroom management procedure in her classroom and would occasionally review the school-wide and classroom expectations throughout the day.

Classroom 2 was a first grade classroom with 19 students. The targeted intervention period was English and lasted between 15 minutes and an hour. English instruction consisted of whole group instruction, individual reading, and group assignments. The students in the study were 52.9% White, 41.2% Hispanic, and 5.9% Black. Forty-one percent of the students in the study were ELL. The students were 35.3% females and 64.7% males, and 84.2% of the class qualified for free or reduced lunch. Teacher 2 was a white, non-Hispanic female in her 30's with 10 years of teaching experience. The teacher has a bachelor's degree in communications and completed other requirements in order to teach in the school system. Teacher 2 also used a color clip chart as a classroom management procedure in her classroom.

Potential target classrooms were recruited through teacher interviews and classroom observations. Teacher interviews consisted of questions (Appendix A) to identify possible disruptive behavior, problematic instructional time periods, and the number of students who engaged in disruptive behavior and who had difficulties with academic engagement. After the teacher interview was completed, a classroom observation was conducted to confirm the presence of disruptive behavior during a potential target instructional time period. In order to document the overall level of class-wide disruptive behavior, a planned activity check (PLACHECK), a variation of a momentary time sampling procedure was used to record the number of students who engaged in disruptive behavior at the end of each interval. Data were collected in 2-minute intervals throughout an instructional time period. An overall percentage of students engaged in disruptive behavior was calculated at the end of the observation. In order to meet criteria for inclusion, at least 20% of students in the classroom must have engaged in disruptive behavior throughout the observed instructional time period.

Materials

iClicker2, an electronic interactive classroom response system, computer, LCD panel, and Microsoft PowerPoint were used in this study. iClicker2, which allows students to respond with both letters and numbers in addition to multiple choice responses, was used to allow students to respond to teacher questions. The iClicker2 software was placed on a USB drive that the teacher plugged into the computer. The computer had Windows XP, Mac OS X 10.6, or higher operating software. The LCD EPSON projector panel was used to project the images from the PowerPoint presentation onto the screen. PowerPoint version 2007 or higher was used to create questions during the intervention.

Measures and Data Collection

The dependent variables in this study included teacher implementation fidelity and student academic engagement, disruption, and quiz performance at class-wide level. Observers (researcher and three research assistants) collected data through direct observations in the classroom during target instructional time periods. Research assistants were graduate students from the Applied Behavior Analysis program. Assistants were trained on collecting direct observational data on treatment fidelity and class-wide student behavior and by watching and scoring a YouTube video of classroom students that were similar to the behaviors and scenarios they would be observing in the classroom. In order to begin data collection for the study, research assistants were required to score above 80% interobserver agreement during training. Classroom observations occurred 2-5 times per week during select instructional periods. Data were collected through the use of paper and pencil and an electronic timer to indicate the different intervals for time sampling and the use of the student response system, iClicker2 software. Observational periods varied in length depending on the target academic time. At the end of intervention social validity was assessed with teachers and students.

Teacher implementation fidelity. Observers recorded teacher implementation fidelity during 100% of the electronic student response system sessions, using a 10-item treatment fidelity checklist (Appendix D) to assess the teachers' implementation of the intervention components. The checklist included yes, no, or n/a responses for each component to measure the percentage of steps or procedures implemented correctly. The fidelity checklist included two components (e.g., software setup and instructions), which were broken down to ten steps. Each step was measured based on teacher adherence and quality. Adherence was measured if the step was implemented and quality measured how accurately the teacher implemented each step. The

percentage of implementation fidelity was calculated by dividing the total number of yes responses by the total of yes and no responses to represent an overall fidelity of adherence and quality and overall implementation.

Academic engagement. Class-wide student engagement in academic activities was measured by collecting data on the percentage of students who participated in question-and-answer activities during target instructional time periods. During baseline, teachers would verbally ask questions to students throughout the instructional time period and students would respond by raising their hands. Observers would scan the classroom to count the number of students who raised their hand for each question, record the number on a frequency count recording sheet (Appendix B), sum the counts to reach a total number of students who raised their hand per question, and then calculated the mean percentage of students who raised their hand to determine an estimate of class-wide academic engagement. During intervention, the mean percentage of students who responded to questions via clicker was measured; data that were automatically generated by the clicker were used to obtain the percentage of students who responded to questions.

Disruptive behavior. Student disruptive behavior at class-wide level was measured using PLACHECK in 2-minute intervals (Appendix C). Disruptive behavior was defined jointly by the researcher and teacher during the initial meeting based on each teacher's classroom environment. Teachers 1 and 2 defined disruptive behavior as: attending to materials unrelated to instruction (e.g., sharpening pencils during instruction, pushing buttons on calculators (causing other students to attend to them, and pushing buttons on a small timer), looking away from materials or instruction (e.g., attending or responding to peer's disruptive behavior), getting out of seat without permission, and calling out or talking without permission. At the end of each time

interval, observers recorded the number of students engaged in disruptive behavior and then obtained the percentage of students engaged in disruption at each check. The mean percentage of students engaged in disruption was determined by adding the percentage of students engaged in disruption at each check and dividing the number by the total number of checks.

Quiz performance. Student performance on weekly quizzes was measured through permanent product (i.e., paper worksheets and pencils) at the end of baseline and intervention phases. The number and percentage of correct responses answered on each quiz provided in paper-pencil format were obtained for each student and then the mean percentage of correct responses were calculated to determine the overall class-wide level of academic performance. The quizzes consisted of 10 multiple-choice or true/false questions related to the material that was covered for the week. The researcher assisted the teacher in creating questions based on the week's topic. During baseline and intervention, the quizzes were given at the end of the instructional period. The amount of time the teacher provided to complete the quiz varied.

Social validity. At the end of the intervention, students and teachers completed a social validity survey (Appendix E) examining their acceptability and satisfaction with the use of the electronic student response system. Teacher surveys were conducted using a modified version of the Intervention Rating Profide-15 (IRP-15; Martens, Witt, Elliott, & Darveaux, 1985) that contains 15 items rated on a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree) and designed to measure social validity of school-based interventions. The original IRP-15 was modified to include information specific to student response systems and class-wide behavior. The students completed a survey consisting of 8 yes/no questions (e.g., "I enjoyed using the clicker in my class.", "I answered more questions using the clicker.")

regarding their opinions on the student response system during instruction and if they enjoyed using the clicker.

Interobserver agreement (IOA). Throughout the study, a second observer collected data on the targeted classroom behavior and teacher implementation fidelity simultaneously, but independently from the other observer. IOA was assessed for at least 30% of the sessions during the study, distributed across phases, classrooms, and direct observation measures. IOA for fidelity was calculated by dividing the number of steps agreed by the number of steps agreed plus disagreed. IOA for academic engagement was calculated by dividing the smaller number by the bigger number and multiplying by 100. IOA for disruptive behavior was calculated by dividing the smaller number by the bigger number for each recorded check and multiplying by 100, adding these percentages together and dividing by the total number of checks. IOA for quiz performance was calculated using a point-by-point (item-by-item) method by dividing the number of questions agreed by the number of questions agreed plus disagreed. These scores were then converted into a percentage for total agreement. The mean IOAs were 100% for fidelity, 86.6% for academic engagement, and 39% for disruption. The mean IOAs were 44.8% in baseline and 80% in intervention across classrooms.

Experimental Design and Procedures

The outcome of the student response system intervention was examined using an ABAB and ABA reversal designs embedded within a multiple baseline design across classrooms; due to time constraint caused by difficulty obtaining informed consents from students' parents, an ABA reversal design was used for one classroom. The experimental conditions included baseline (BL) and student response systems (SRS). Before baseline data collection began, the purpose of the study and a brief description of student response systems was explained to each teacher. The

teacher and researcher jointly determined a target academic period, defined disruptive behavior, and generated academic content questions to be used during instructional activities for the classroom.

Teacher training. Teacher training took place at a designated location and time convenient for each teacher. Training sessions lasted approximately one hour and were conducted individually. During the training, the researcher explained the use of the student response system, iClicker2, and the implementation procedures and materials to participating teachers. Training included printed handouts, a PowerPoint presentation that included sample questions and information on electronic student response systems, and the iClicker2. During training, the researcher used behavioral skills training to train the teachers how to use the electronic student response system. Teachers received a student response system procedures sheet that they could reference during student training and the intervention. The sheet included a step-by-step checklist for setting up the iClicker2 system, a list of the steps for student responding, and a brief statement to read to the students on the use of the system. System setup instructions allowed teachers to ensure that the software was loaded and the clickers were set up to respond appropriately to the questions asked in class through the responder. The student responding procedures provided the teacher with the steps required for students to respond and how to display the class responses after a question had been asked.

Training began with instruction on using the electronic student response system. The researcher then modeled using the system and had the teachers practice using the system. After the teachers practiced using the system, the researcher provided feedback to the teachers on their performance. During the training, teachers were instructed to provide students 15-20 seconds to respond to questions after each question has been stated and practiced this skill. Teachers were

taught how to record student answers to instruction questions using the iClicker2 software and how to save student responses to the iClicker2 gradebook database. This database allowed teachers to review entire class responses for each question to track correct responses. Teachers had several examples during the training to help them practice recording responses. Teacher training was completed when the teacher could perform 80% or more of the steps of the student response system setup without researcher prompting. At the end of training, the teachers determined the specific time of day that the student response system would be used.

Baseline. During this condition, the teacher conducted classroom instruction as usual. Student response systems and any related materials were not presented during this condition. The school utilized posters to teach the rules and expectations of the school to the students and a reward system to reinforce students' appropriate behaviors. During the instructional time period, teachers verbally asked students questions. The teachers began the class as usual reviewing the previous lesson, lecturing the new topic, providing questions, and engaging students in independent work. During the question and answer period, the teachers provided the students varied time to think about the question, raise their hand and then call on students who raised their hand to answer questions. The number of questions used across sessions varied slightly; between 6-10 questions for Classroom 1 and 5-17 questions for Classroom 2 were given during the instruction. Observers collected data on student disruptive behavior and academic engagement during the instructional time period (e.g., math, English) in every session. Baseline data were collected 2-3 days per week.

Student response system intervention. Prior to implementing intervention, the teacher provided a 15-20-minute training session to students by reading a brief summary about the iClicker2 and engaging them in practice for responding to questions using the clicker. Teacher-

student interactions during intervention were similar to the regular instructional periods; except each student had a chance to respond to teacher questions using the iClicker2. Prior to each instructional session, the teacher and researcher created a PowerPoint with multiple choice and/or true or false questions for the session. Throughout the lecture, the teacher referenced the PowerPoint and had the students respond to a question. The number of questions during each lecture varied slightly. As with baseline, between 4 and 10 questions for Classroom 1 and 6 and 11 for Classroom 2 were given to students. Teachers provided the students at least 15-20 seconds to respond to questions after the question and answer choices had been read to the students. After the teacher had provided the students at least 15-20 seconds to respond to a question, the teacher displayed a visual graph showing the students' responses and reviewed the correct answer. If less than 50% of the students responded correctly to a question, the teacher reviewed the correct answer with the students and explained why that answer was the correct answer. For example, the teachers reviewed the steps for solving a math problem or rereading the sentence of a story where the information was found. The teachers occasionally provided praise (e.g., "Great job everyone! You're right!") to the class for their correct responses to the questions. At the conclusion of the intervention, teachers and students were given a survey to examine the social validity in the classroom. Teachers placed the student surveys and teacher survey in an envelope and turned the envelope into the front desk mailbox to ensure anonymity.

Students in the classroom who did not participate in the research study still participated in the class instruction and were provided a clicker to respond to teacher questions during the intervention. The students who did not participate also completed class quizzes along with the other students in the class; however, the students' quizzes were not used in the study.

Chapter 3:

Results

Teacher Implementation Fidelity

The first research question was to determine whether teachers could implement the electronic response system intervention with fidelity. As shown in Figure 1, both Teacher 1 and Teacher 2 demonstrated high levels of implementation fidelity during the first intervention phase. Average implementation fidelity across sessions was 93.1% (range 77.8-100%) for Teacher 1 and 100% for Teacher 2. The data clearly indicates that the teachers consistently implemented the student response system intervention. However, in the second intervention phase, Teacher 1's implementation fidelity decreased to 77.8% during the last session.

Academic Engagement and Disruptive Behavior

The second research question was to determine the extent to which the electronic response system could improve class-wide behavior. Figure 1 also depicts data on class-wide academic engagement and disruptive behavior across two classrooms during instructional time periods. As with academic engagement, the data clearly indicate that implementation of the electronic student response system with fidelity by classroom teachers led to positive student outcomes. In the initial baseline condition, both classrooms showed low levels of academic engagement. However, when the student response system was implemented, there was an immediate increase in academic engagement (as measured by the percentage of students engaged

in academic activities) in both classrooms, and the improved high levels of engagement consistently sustained over time as sessions progressed, demonstrating stability or an increasing trend. During withdrawal of intervention, the levels of academic engagement reversed completely to the initial baseline level for both classrooms indicating that the intervention was successful in increasing academic engagement. The reintroduction of the electronic student response system to Classroom 1 in the second intervention phase further demonstrated that the response system had a positive impact on the class-wide behavior; upon reintroduction of the intervention, the classroom's academic engagement dramatically increased to the same level seen in the first intervention phase.

The data also indicate that implementation of the electronic student response system with fidelity by the classroom teachers was associated with decreased class-wide disruption. Although the changes in the mean levels were minimal, compared to baseline, both classrooms showed low levels of disruptive behavior in the initial intervention phase. Additionally, the increasing trend upon withdrawal of intervention and the reversed, decreasing trend upon reintroduction of intervention demonstrated by Classroom 1 clearly indicated that the electronic student response system resulted in decreased class-wide disruptive behavior. Table 1 summarizes mean percentages of academic engagement and disruption across experimental phases for each classroom.

Quiz Performance

The third research question was whether the electronic student response system would positively impact student quiz performance. Pre-and post-scores were compared in order to examine whether student quiz performance changed after intervention. For Classroom 1, pre-post intervention quizzes provided at the end of the second baseline and intervention phases were

compared, and for Classroom 2 pre-post quizzes provided at the end of initial baseline and intervention phases were compared. As seen in Figure 2, the pre-post data indicated that the electronic student response system did not positively impact student performance on quizzes. The class-wide quiz performance remained at the same level (93%) for Classroom 1 whereas the quiz performance decreased from 83% in baseline to 69% in intervention for Classroom 2. However, 55.5% of students in Classroom 1 and 31.3% of students in Classroom 2 improved or maintained their scores from baseline to intervention although the overall class-wide quiz performance did not improve from baseline to intervention.

Social Validity

The fourth question addressed the social validity of the electronic student response system. The teacher and student social validity survey data were overall positive for both classrooms. Overall rating by Classroom 1 teacher was a mean of 2.7 out of 5.0. Teacher 2 rated a mean of 4. Teacher 1 rated 1 or 2 and Teacher 2 rated 3 or 4 for statements regarding the effects of the student response system on class-wide disruptive behavior. Both teachers rated 4 or 5 on statements regarding their willingness to implement the intervention and the frequency of class-wide behaviors to warrant the intervention. Table 2 summarizes the social validity data from the teachers.

On average, 68% of the students in Classroom 1 rated "yes" across items. The students' responses showed that 90% of the students liked using the clickers and 80% of the students would like to use the clickers again. They also highly rated that the clickers helped them answer questions in class and they answered more questions during class. On average, 86% of the students in Classroom 2 rated "yes" across items. The students' responses indicated that 100% of the students liked using the clickers and would like to use them again, 94% of the students felt

that the clickers helped them answer questions in class, and 100% of the students felt that they answered more questions during class. When the average was calculated with the exception of the statements “I enjoyed seeing the classes’ answers.” and “Seeing my classes’ answers helped me understand the correct answer.”, students in Classroom 1 rated “yes” 81.7% and Classroom 2 rated 90% for statements related to academic engagement. Table 3 summarizes the social validity data from the students.

Table 1.

Mean academic engagement and disruption across experimental conditions

Condition	Class 1		Class 2	
	Engagement Mean (Range)	Disruption Mean (Range)	Engagement Mean (Range)	Disruption Mean (Range)
A1	40.3 (31.9-48.7)	26.8 (23.5-30.1)	18.8 (15.7-20.7)	25.4 (21-27.3)
B1	86.7 (83.9-90.8)	24.2 (20-25.8)	92.5 (82.7-98.4)	19.6 (16.7-26.3)
A2	28.9 (27-31.9)	29 (24.5-32.9)	26.3	15.1
B2	93 (89.2-97.9)	26.4 (20.8-36)		

Table 2.

Teacher social validity

Item	Teacher 1	Teacher 2
1. This was an acceptable intervention for my classroom.	3	4
2. This intervention was appropriate for a variety of problem behaviors.	2	3
3. This intervention was effective in changing class-wide behaviors.	1	4
4. I would suggest the use of this intervention to other teachers.	3	4
5. Class-wide behaviors were frequent enough to warrant the use of this intervention.	4	4
6. Most teachers would find this intervention suitable for the targeted class-wide behaviors.	2	4
7. I was willing to implement the intervention.	5	4
8. The intervention did not have negative side-effects for the students.	2	5
9. The intervention would be appropriate for a variety of classrooms and grade levels.	4	5
10. The intervention was not disruptive to the class schedule.	4	5
11. I liked the procedures used in the intervention.	3	4
12. The intervention improved the class-wide behavior during the targeted instructional time and other instructional periods.	1	4
13. The class-wide behavior seems likely to remain at an improved level even after the intervention is discontinued.	3	3
14. Other class-wide behaviors related to the disruptive behaviors improved by the intervention.	1	3
15. Overall, the intervention was beneficial for the classroom.	3	4
Average Rating	2.7	4.0

Table 3.

Student social validity

Question	Students Classroom 1			Students Classroom 2		
	n	Yes	No	n	Yes	No
1. I enjoyed using the clicker in my class.	10	80%	20%	17	100%	0%
2. I participated more in class using the clicker.	10	90%	10%	17	70%	30%
3. I would like using the clicker again in my class.	10	80%	20%	17	100%	0%
4. I listened more to my teacher's instruction using the clicker.	10	80%	20%	17	76%	24%
5. The clicker helped me answer my teacher's questions.	10	90%	10%	17	94%	6%
6. I enjoyed seeing the classes' answers.	10	30%	70%	17	65%	35%
7. I answered more questions using the clicker.	10	70%	30%	17	100%	0%
8. Seeing my classes' answers helped me understand the correct answer.	10	30%	70%	17	82%	28%
Average	10	68.8%	31.3%	17	86%	14%

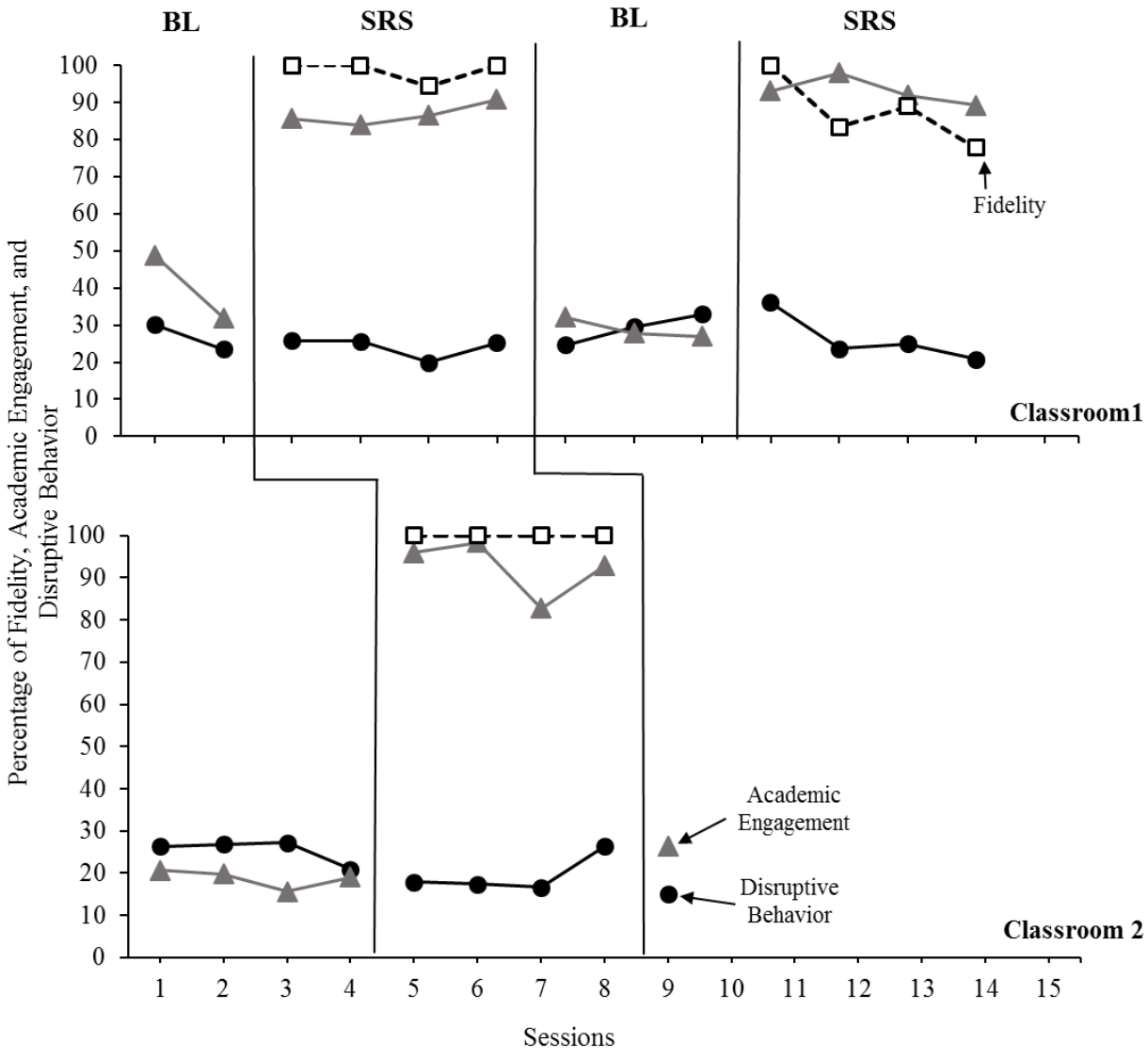

Figure 1. Percentage of implementation fidelity, academic engagement, and disruptive behavior across experimental conditions.

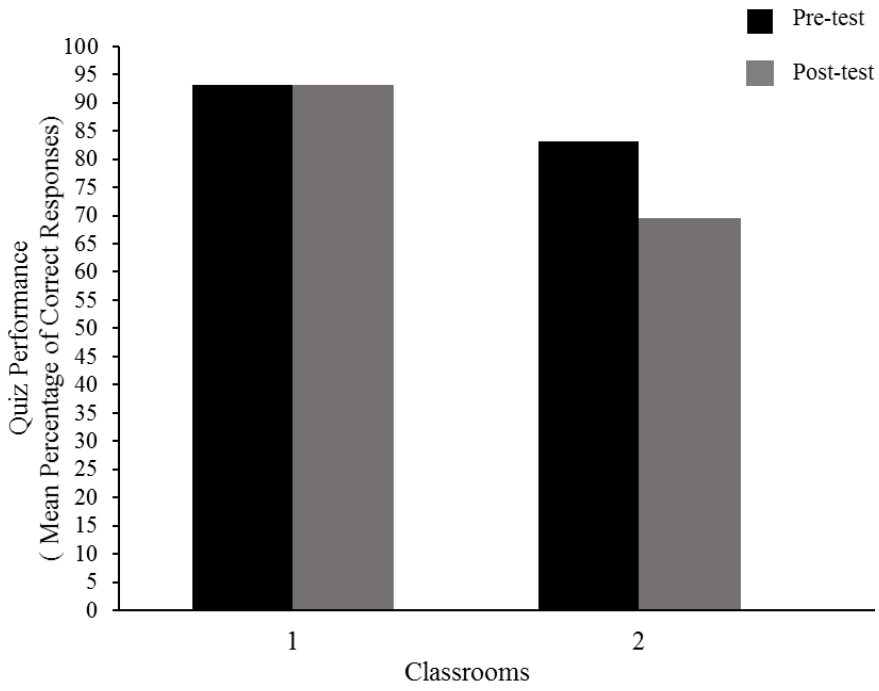

Figure 2. Pre-post test quiz performance across classrooms.

Chapter 4:

Discussion

This study aimed to determine the extent to which the elementary classroom teachers could use the electronic student response system, whether the use of an electronic student response system by the classroom teachers resulted in decreases in class-wide disruptive behavior and increases in academic engagement, whether the response system resulted in improvement in quiz performance, and whether the teachers and students were satisfied with the response system intervention.

The results of the study suggest that the electronic student response system may have a positive impact on class-wide behavior in general elementary classrooms. Teachers could implement the response system intervention with fidelity, and their implementation of the intervention was positively associated with increases in class-wide academic engagement and a reduction in disruptive behavior to some degree although the intervention did not have an impact on student quiz performance. Social validity data indicated that the electronic response system intervention was acceptable to both teachers and students to some degree.

The participating teachers were able to learn all of the procedures for implementing the student response system in the initial training session and had a high fidelity throughout all of the intervention sessions. Although Teacher 1's fidelity dropped to 78% in the last session of the second intervention phase due to point loss in accuracy, the teacher earned points for adherence of implementation for all of the implementation steps with an exception of one step. This may

imply that elementary classroom teachers can easily implement the electronic student response system intervention and that use of the system may increase the consistency of implementing the intervention.

The current study extends previously conducted studies on electronic student response systems. As demonstrated by a few studies (Kaleta et al., 2007; Salamonson et al., 2009; Stowell & Nelson, 2007) and confirmed by this study, the use of the student response system has the potential to improve student academic engagement in the classroom setting; for students who might be unlikely to raise their hand during baseline, the student response system increased their responses during instruction. Specifically, this study extends the literature on the use of electronic student response systems in primary elementary classrooms to decrease problem behavior (Szwed & Bouck, 2013). As indicated in the previous study (Clauson et al., 2012; Medina et al., 2008), the teachers and students in the current study had overall positive ratings on the use of the student response system. The teachers agreed that the response system would be appropriate for a variety of classrooms and grade levels. The teachers also agreed that the intervention was not disruptive to their class schedule. Students gave an overall positive rating on most of the statements on the survey indicating that they enjoyed using the system during academic activities.

This study is the one of the first few studies that investigated the use of electronic student response systems in elementary school settings. During implementation of the intervention, it was observed that when the students were allowed to operate the electronic system to respond to teacher questions, they were excited and used the system with little teacher prompting. This may imply that primary elementary students can use the electronic response system easily, and the system can promote their interest in engaging in academic activities. Considering that the

majority of the studies on electronic student response system targeted college students and that children often prefer mobile devices or computer-assisted instruction (Ronimus, Kujala, Tolvanen, & Lyytinen, 2014), certainly, more studies on the use of electronic student response systems should be conducted in the elementary school settings.

This study also demonstrates the potential benefits of using electronic student response systems as a class-wide intervention within SWPBS. Given that classroom management and disruptive behavior are significant concerns for teachers and that many teachers report being unprepared in effective classroom management (Närhi, Kiiski, Peitso, & Savolainen, 2015; Reinke, Stormont, Herman, & Newcomer, 2014), providing high rates of opportunities to respond activity, thereby, reducing disruption during instructional time using the electronic student response system may result in reducing the number of students needing Tier 2 or Tier 3 interventions. The reduction of students needing Tier 2 interventions would save schools resources for other needs throughout the school.

Although this study contributes to the existing literature on electronic student response systems, it has limitations. First, the impact of the use of the response system on disruptive behavior was minimal. However, the classrooms in the current study were general education classrooms with relatively low rates of disruptive behavior before the intervention was put in place. Although disruptive behavior decreased slightly, these are favorable results for a classroom with initial lower rates of disruptive behavior. In addition, it was observed that due to being excited about using the clicker some of the students would get out of their seat to stand and answer questions using the clicker and talk with their classmates after they answered questions, which was included in the definition of the disruptive behavior. Thus, it is possible that the definitions of disruptive behavior likely overestimate the occurrence of disruptive behavior.

Future studies should examine the use of a student response system in classrooms with higher rates of disruptive behavior and include exclusion criteria in their definition of disruptive behavior to account for students who are still actively engaged in the teacher's instruction.

The current study examined academic engagement based on hand-raising and clicker responses. Although this showed an increase in academic engagement during the student response system intervention, future studies should expand on the definition of academic engagement during instruction. Academic engagement should include discussing the question with peers unless the teacher states that the students should respond independently. Future studies should also examine student academic engagement based on the structure of the questions. For example, comparing student academic engagement for multiple choice questions to constructed responses.

Second, due to time constraint, caused by conducting the study towards the end of the school year, the study failed to collect more than one data point in the withdrawal phase and to conduct the second intervention phase with Classroom 2; thus, it is difficult to determine the generality that can be made to a wider range of classrooms. The small sample size further limits the generality of the study. Future research using a larger sample of classrooms would increase confidence in the findings.

Third, the study took place over a relatively short period of time. The length of the study provides a possible weakness. Due to urgent needs for intervention, the initial baseline data were collected during only two sessions in Classroom 1, and the short data collection time frame and the limited data points may impact the study validity. Although disruptive behavior in the initial baseline for Classroom 1 was on a decreasing trend, intervention was introduced due to time constraints towards the end of the school year and limited time availability for the teacher to

complete the clicker training. Further, due to the short study time frame, quiz performance data were limited to one probe in each baseline and intervention phase for each classroom, which limits the validity of the study. Additional research over longer periods of time should be warranted.

Fourth, the current study examined class-wide behavior during a single academic subject area. Future studies using the electronic student response system should examine class-wide student behavior across academic subjects, which would allow studies to compare the impact of the response system on students' responses and behavior across different academic time periods.

Fifth, the study did not examine the long-term impact of the intervention; thus, it is difficult to determine whether the electronic student response system can sustain class-wide behavioral changes over extended time period. Future research should evaluate the extent to which class-wide behavior changes are maintained after intervention is terminated.

Sixth, the quizzes given throughout the study were created based on the material taught during the teachers' instruction; they were not based on a standardized assessment and were different from the questions asked during the instructional time. Additionally, the wording used in the questions might have been difficult for students to understand compared to the questions asked during the instruction. Future studies should examine student quiz performance based on questions previously asked during the instruction vs. questions previously not asked during the instruction. Another issue with low quiz performance post intervention could be due to the increasing difficulty of the instruction throughout the school year. Students might have performed lower on the quiz after intervention because of the material that was covered during the week. Future studies should examine quiz performance based on the difficulty levels of instruction throughout the school year.

Seventh, one possible limitation with the student social validity surveys is the way teachers' presented the questions. The researcher was not present when the teacher provided the surveys, but the teachers reported that they read the questions to the students while they filled out the questions. The teachers' tone when reading the questions could have affected the students' responses, and students might have made comments or talked with other classmates about their responses.

Despite its limitations, this study offers a contribution to the body of research on electronic student response systems and technology-based intervention for classrooms with high number of students engaging in disruptive behavior. This study is one of the first studies to evaluate the potential efficacy of the electronic student response system at the class-wide level in the elementary school settings. It provides an initial empirical support for the use of an electronic student response system as a promising and acceptable intervention by elementary classroom teachers for improving class-wide student behavior.

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Appendices

Appendix A: Teacher Initial Interview

Teacher Initials:_____ Grade Level:____ Date:_____

Teacher Initial Interview

This study will evaluate the use of a student response system on class-wide student behavior. Data will be collected on class-wide disruptive behavior, academic engagement, and correct responding. Additionally, teacher and student responses will be collected based on the intervention.

Please fill out the table below with information pertaining to your classroom.

Instructional times in which disruptive behaviors occur (i.e. Science)	Approx. # of students engaging in disruptive behavior	Disruptive behaviors	How often do the behaviors occur?

Appendix B: Frequency Count Data Sheet

Classroom:_____ Date:_____

Start Time:_____ Stop Time:_____ Observer:_____

# of Students:_____ # of Teachers:_____

Frequency Count: Academic Engagement

Instructions: Record the number of students responding to each answer for each question (If the question is True/False, circle/highlight the T/F for that question)

Question	Student Responses				
1	A:_____	B:_____	C:_____	D:_____	T/F
2	A:_____	B:_____	C:_____	D:_____	T/F
3	A:_____	B:_____	C:_____	D:_____	T/F
4	A:_____	B:_____	C:_____	D:_____	T/F
5	A:_____	B:_____	C:_____	D:_____	T/F
6	A:_____	B:_____	C:_____	D:_____	T/F
7	A:_____	B:_____	C:_____	D:_____	T/F
8	A:_____	B:_____	C:_____	D:_____	T/F
9	A:_____	B:_____	C:_____	D:_____	T/F
10	A:_____	B:_____	C:_____	D:_____	T/F
11	A:_____	B:_____	C:_____	D:_____	T/F
12	A:_____	B:_____	C:_____	D:_____	T/F
13	A:_____	B:_____	C:_____	D:_____	T/F
14	A:_____	B:_____	C:_____	D:_____	T/F
15	A:_____	B:_____	C:_____	D:_____	T/F
16	A:_____	B:_____	C:_____	D:_____	T/F
17	A:_____	B:_____	C:_____	D:_____	T/F
18	A:_____	B:_____	C:_____	D:_____	T/F
19	A:_____	B:_____	C:_____	D:_____	T/F
20	A:_____	B:_____	C:_____	D:_____	T/F

On the back of this page:

Calculate the percentage of students that are actively engaged for each question by dividing the number of students that answered the question by the number of students in the classroom during the observation.

Calculate the percentage of correct responses for each question by dividing the number of correct responses by the number of responses that were given.

Question	Academic Engagement
1	%
2	%
3	%
4	%
5	%
6	%
7	%
8	%
9	%
10	%
11	%
12	%
13	%
14	%
15	%
16	%
17	%
18	%
19	%
20	%

Academic engagement: Add up all the percentages for academic engagement during the observation period and divide by the number of questions.

Sum of Percentages: _____ # of Questions: _____

Academic Engagement: _____ / _____ = _____

Appendix C: PLACHECK Data Sheet

Classroom:_____ Date:_____

Start Time:_____ Stop Time:_____ Observer:_____

# of Students:_____ # of Teachers:_____

PLACHECK: Disruptive Behavior (2-min intervals)

Instructions: Record the number of students observed engaging in disruptive behavior at the end of each interval

Disruptive Behavior:_____

Minutes	# of Students Engaging in Disruptive Behavior	% of Students in the Classroom Engaging in Disruptive Behavior
2		%
4		%
6		%
8		%
10		%
12		%
14		%
16		%
18		%
20		%
22		%
24		%
26		%
28		%
30		%

Sum of Percentages:_____ Total # of Intervals:_____

Percentage of Students Engaging in Disruptive Behavior:_____ / _____ = _____

Appendix D: Teacher Implementation Guide

Classroom:_____ Date:_____

Start Time:_____ End Time:_____ Observer:_____

Number of Students:_____ Number of Teachers:_____

Teacher Implementation Guide

	Was the intervention implemented? (Adherence)	Was the intervention done accurately? (Quality)	Fidelity Score Y/Y=2 Y/N=1 N/N=0 NA/NA=NA
Plugs the iClicker2 receiver into the computer. 1. Plugs in the iClicker2 receiver before beginning instruction.	Y / N / NA	Y / N / NA	
Plugs the USB with the iClicker2 software into the computer. 1. Plugs in the USB with the iClicker2 software before beginning instruction.	Y / N / NA	Y / N / NA	
Signs into the iClicker2 software. 1. Signs into the iClicker2 software before beginning instruction.	Y / N / NA	Y / N / NA	
Checks the radio frequency to ensure it is on the right frequency. 1. Checks the frequency to ensure it is on the same frequency as the clickers before beginning instruction.	Y / N / NA	Y / N / NA	
Instructs students to turn on their clickers. 1. Instructs students to turn on their clickers at the beginning of instruction.	Y / N / NA	Y / N / NA	
Allows students time to respond to each question. 1. Provides students 10-15 seconds to respond to questions. (may miss 1-2)	Y / N / NA	Y / N / NA	
Displays graph after students respond to a question. 1. Displays graph after providing the students time to answer each question. (may miss 1)	Y / N / NA	Y / N / NA	
Discusses the correct answer with the students. 1. States the correct answer with the students for each question. (may miss 1)	Y / N / NA	Y / N / NA	

Discusses why the answer is correct for questions in which less than 50% of the students respond correctly. 1. Provides a brief review of why the answer is correct if less than 50% of the students answer correctly. (may miss 1-2)	Y / N / NA	Y / N / NA	
Ends the session using the iClicker2 software. 1. Ends the session of the iClicker2 software after the instructional period ends.	Y / N / NA	Y / N / NA	
Implementation Scores (Total Y's/Total Y's + N's in Column)			
Total Implementation/Fidelity Score (Total Y's/Total Y's + N's across 2 domains)			

Implementation scoring key:

1. **Plugs the iClicker2 receiver into the computer.**
   Adherence: Teacher plugs the iClicker2 receiver into the computer.
   Quality: Teacher plugs the iClicker2 receiver into the computer before beginning the instruction.
2. **Plugs the USB with the iClicker2 software into the computer.**
   Adherence: Teacher plugs the USB with the iClicker2 software into the computer.
   Quality: Teacher plugs the USB with the iClicker2 software into the computer before beginning the instruction.
3. **Signs into the iClicker2 software.**
   Adherence: Teacher signs into the iClicker2 software.
   Quality: Teacher signs into the iClicker2 software before beginning the instruction.
4. **Checks the radio frequency to ensure it is on the right frequency.**
   Adherence: Teacher checks the radio frequency to ensure it is on the right frequency.
   Quality: Teacher checks the radio frequency to ensure it is on the right frequency before beginning the instruction.
5. **Instructs students to turn on their clickers.**
   Adherence: Teacher instructs students to turn on their clickers.
   Quality: Teacher instructs students to turn on their clickers before beginning the instruction.
6. **Allows students time to respond to each question.**
   Adherence: Teacher allows students time to respond to each question. (may miss 1-2)
   Quality: Teacher allows students 10-15 seconds to respond to each question. (may miss 1-2)
7. **Displays graph after students respond to a question.**
   Adherence: Teacher displays graph after students respond to a question. (may miss 1)
   Quality: Teacher displays graph after students respond to a question. (may miss 1)
8. **Discusses the correct answer with the students.**
   Adherence: Teacher discusses the correct answer with the students. (may miss 1)
   Quality: Teacher discusses the correct answer with the students. (may miss 1)
9. **Discusses why the answer is correct for questions in which less than 50% of the students respond correctly.**
   Adherence: Teacher discusses why the answer is correct for questions in which less than 50% of the students respond correctly. (may miss 1-2)
   Quality: Teacher discusses why the answer is correct for questions in which less than 50% of the students respond correctly. (may miss 1-2)
10. **Ends the session using the iClicker2 software.**
    Adherence: Teacher ends the session using the iClicker2 software.
    Quality: Teacher ends the session using the iClicker2 software at the end of the instructional time.

Appendix E: Teacher Social Validity Form

Teacher Social Validity Form

Please circle the number that best describes your agreement or disagreement with each statement using the scale below. Please let the researcher know if you have any questions.

1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree

1. This was an acceptable intervention for my classroom.	1 2 3 4 5
2. This intervention was appropriate for a variety of problem behaviors.	1 2 3 4 5
3. This intervention was effective in changing class-wide behaviors.	1 2 3 4 5
4. I would suggest the use of this intervention to other teachers.	1 2 3 4 5
5. Class-wide behaviors were frequent enough to warrant the use of this intervention.	1 2 3 4 5
6. Most teachers would find this intervention suitable for the targeted class-wide behaviors.	1 2 3 4 5
7. I was willing to implement the intervention.	1 2 3 4 5
8. The intervention did not have negative side-effects for the students.	1 2 3 4 5
9. The intervention would be appropriate for a variety of classrooms and grade levels.	1 2 3 4 5
10. The intervention was not disruptive to the class schedule.	1 2 3 4 5
11. I liked the procedures used in the intervention.	1 2 3 4 5
12. The intervention improved the class-wide behavior during the targeted instructional time and other instructional periods.	1 2 3 4 5
13. The class-wide behavior seems likely to remain at an improved level even after the intervention is discontinued.	1 2 3 4 5
14. Other class-wide behaviors related to the disruptive behaviors improved by the intervention.	1 2 3 4 5
15. Overall, the intervention was beneficial for the classroom.	1 2 3 4 5

Appendix F: Student Social Validity Form

Student Social Validity Form

Instructions: Circle "Yes" or "No" based on the clickers used in your class.

1. I enjoyed using the clicker in my class.	Yes No
2. I participated more in class using the clicker.	Yes No
3. I would like using the clicker again in my class.	Yes No
4. I listened more to my teacher's instruction using the clicker.	Yes No
5. The clicker helped me answer my teacher's questions.	Yes No
6. I enjoyed seeing the classes' answers.	Yes No
7. I answered more questions using the clicker.	Yes No
8. Seeing my classes' answers helped me understand the correct answer.	Yes No

Appendix G: USF IRB Approval

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
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2/4/2015

Ashley Horne, B.S.
ABA-Applied Behavior Analysis
13301 Bruce B. Downs Blvd
Tampa FL 33612

RE: **Expedited Approval for Initial Review**
IRB#: Pro00020154
Title: An Evaluation of an Electronic Response System in Improving Class-wide Behavior

Study Approval Period: 2/4/2015 to 2/4/2016

Dear Ms. Horne:

On 2/4/2015, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents outlined below.

Approved Item(s):
Protocol Document(s):
Ashley_Horne_Proposal_V1

Consent/Assent Document(s)*:
IC Parent.pdf
IC Teacher.pdf

Consent/Assent Script(s):
Student Assent

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR

56.110. The research proposed in this study is categorized under the following expedited review category:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Per CFR 45 Part 46, Subpart D, this research involving children was approved under the minimal risk category 45 CFR 46.404: Research not involving greater than minimal risk.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John A Schinka, Ph.D.

John Schinka, Ph.D., Chairperson
USF Institutional Review Board