Long-term Effects of Response Cards on Student Engagement and Academic Performance by Students with Disabilities

by

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Abstract

Title: Long-term Effects of Response Cards on Student Engagement and Academic Performance by Students with Disabilities

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This study examined the effects of response cards on student engagement and academic performance during math instruction. Students in a middle school classroom for students with emotional and behavior disorders (EBD) received two different instructional conditions: (a) hand raising or (b) response cards. An experimental group was compared to a control group on three identical academic tests administered at various times throughout the school semester to evaluate long-term effects of response cards on academic performance. Analysis of the results indicated increases in student engagement when response cards were implemented when compared to sessions during which students used hand raising to indicate a correct answer. Performance on the academic tests indicated academic material was retained over time in both groups.
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Dedication

I dedicate this thesis to my family and friends.

Thank you for your support throughout this journey.
Introduction

Compared to students in any category of disability, students labeled with Emotional Disturbances (ED) or Emotional Behavioral Disorders (EBD), are at the greatest risk for school failure, have the poorest academic records, and have the highest dropout rates (U.S. Department of Education, 2013). Approximately half a million students are identified with EBD in schools across the United States (Wagner, Kutash, Duchnowski, Epstein, & Sumi, 2005). Under the Individuals with Disabilities Education Act (IDEA), special education and related services are mandated by law to be available free of charge to every eligible child (ages 3 to 21) with a disability, including students with EBD. IDEA defined EBD as a condition exhibiting an inability to learn which cannot be explained by intellectual, sensory, or health factors, an inability to build or maintain satisfactory interpersonal relationships, inappropriate types of behavior or feelings under normal circumstances, a general pervasive mood of unhappiness or depression, or a tendency to develop physical symptoms or fears associated with personal or school problems (Code of Federal Regulations, 2007). One or more of the previous characteristics must be exhibited over a long period of time and to a degree that adversely affects a child’s educational performance.
Observed behavioral or emotional responses must be based on multiple sources of data, one of which must be school-related (U.S. Department of Education, 2013). For example, frequent noncompliance with teacher-given instructions, aggression towards staff and/or peers, and academically performing below grade level. In addition, the student must have been unresponsive to direct interventions (e.g., consequences such as detention and suspensions) applied in general education (U.S. Department of Education, 2013).

Educational programs for EBD students include providing emotional and behavior support as well as assistance in mastering academics, developing social skills, and increasing self-awareness, self-control, and self-esteem (Emotional Disturbance Fact Sheet, 2010). For a student whose behavior impedes learning, an Individualized Education Program (IEP) is considered in order to address the problem behavior, including positive behavioral interventions, strategies, and supports (U.S. Department of Education, 2013).

Students with EBD generally earn lower grades, pass competency tests at lower rates, and have more difficulty adjusting to adult life than do students with other disabilities (Emotional Disturbance Fact Sheet, 2010). Young students with EBD displaying academic and behavioral problems
continue to struggle academically and exhibit challenging behaviors into adolescence, causing them to be at serious risk for school failure and dropping out (Montague, Enders & Castro, 2005). In 2011, 37% of students classified as having EBD dropped out of school and stopped receiving special education services. Out of the 5.8 million students served by IDEA, the percentage was substantially larger than the dropout percentage for any other disability category. In 2013, only 52% of students with EBD graduated from high school with a standard diploma (U.S. Department of Education, 2013). These students were also predominantly poor, with 85% qualifying for the free and reduced-price lunch program. Low graduation rates for students with EBD can lead to poor life outcomes, such as criminal behavior and difficulty in securing employment. According to the Office of Juvenile Justice and Delinquency Prevention (1995), 73% of EBD students who have dropped out of school have been arrested.

Behavioral, academic, and social interventions for students with EBD are vital. These interventions focus on developing an appropriate range of social skills needed in order to attend class with other students and teachers. Due to the high number of students at risk for dropping out of school, it is also important to teach these students in a way that increases their participation and academic performance levels (Wagner, Kutash,
Duchnowski, Epstein, & Sumi, 2005). Further exploration of instructional methods to increase student engagement and improve academic performance of students with EBD is crucial. However, the evidence-based literature involving learning strategies for students with EBD is sparse. The focus is based on learning strategies for students, rather than on instructional strategies for teachers.

**Active Student Responding**

The effective use of instructional time is important in learning, and the methods that allow for better use of time are critical (Code of Federal Regulations, 2007). Strategies to increase student responses are typically not stressed in faculty training courses. Fortunately, techniques like guided notes, choral responding, and response cards repeatedly have been shown to have a strong, positive effect on student learning in the classroom (Heward, 2000). When implemented, these techniques produce higher levels of ASR when compared to more traditional teaching approaches (e.g., hand raising) and have a positive effect on student achievement.

In 1916, John Dewey first suggested that students learn by doing. Specifically, as students participate actively in class, they are more likely to recall information and perform better. This evolution from Dewey’s proposition is called Active Student Responding (ASR), and it is defined as
an observable student response made to an instructional antecedent (e.g. responding verbally to a question, writing a response to a math problem, and reading aloud; Barbetta, Heron, & Heward, 1993). Students are encouraged to participate by asking and answering questions. Traditionally, this occurs when a teacher asks one question to the class and one student who is raising his hand is picked to respond. A limitation to the traditional ASR method is that it reduces opportunities for other students to respond, causing them to become passive participants. Having students that are more actively involved not only increases the teaching effectiveness but also decreases problem behaviors in the classroom. For example, more opportunities to respond increases students' learning by engaging more time in instruction and decreasing inactivity in the classroom.

Guided notes are handouts presented by the teacher, and involve more responding on behalf of the student than simply raising a hand. Guided notes guide the student through a lecture using blank spaces in which students are to write key facts, concepts, and/or relationships (Heward, 1996). Guided notes provide opportunities for students to respond and create a summary of the lesson. They also can assist in teaching effective note-tasking skills. Furthermore, guided notes provide students
with specific information to focus on when studying for tests (Barbetta & Skaruppa, 1995).

Choral responding involves students responding in unison to the teacher’s question (Blackwell & McLaughlin, 2005). This strategy allows for immediate student feedback; however, it can be more difficult to monitor lack of responses or individual errors.

Response cards are cards or signs that are simultaneously held up by all students in the class to display their response to a teacher presented question (Cavanaugh, Heward, & Donelson, 1996). The reusable cards can be blank (i.e., write on) or pre-printed. A write-on response card allows a student to write and erase short answers on the card for open-ended questions. Pre-printed response cards permit the student to choose from a selection of true/false or multiple-choice answers. Response cards have been shown to be an effective and efficient way for the teacher to continuously assess students’ responses to a question. When a teacher calls on students individually, as seen with the hand raising method, the teacher can only evaluate the response of the student who was “called on” to answer the question. With response cards, the entire class can answer a teacher-guided question. Students write their answers on the response cards and the teacher instructs all students to raise their cards at the same
time. This allows the teacher to quickly assess all answers and provide immediate feedback while adjusting instruction as necessary. If all students answer correctly, the teacher may move on to the next concept. If the answer was unclear to the students, the teacher may re-teach the concept. Similar to choral responding, response cards also provide immediate feedback. Response cards provide the teacher with a visual stimulus that allows students who are not responding or are responding with errors to be more easily noticeable.

Several studies have evaluated the effectiveness of using response cards compared to hand raising during academic instruction in order to determine the effects on student participation, academic performance, disruptive behavior, and on-task behavior as well as variables involving teachers. Response cards have been used in the elementary school subjects such as social studies (Narayan, Heward, & Gardner, 1990), science (Gardener, Heward, & Grossi, 1994), math (Christle & Schuster, 2003; Lambert et al., 2006), and English vocabulary (Munro & Stephenson, 2009). Response cards have also been used in special education classrooms in order to increase students’ accuracy (Skibo, Mims, & Spooner, 2011), general education classrooms to decrease disruptive behavior (Armendariz & Umbreit, 1999), and in upper division university
courses (Marmolejo, Wilder, Bradley, 2004; Shabani & Carr, 2004). Few studies have focused specifically on the EBD population (Cavanaugh et al., 1996; George, 2010).

Narayan et al. (1990) evaluated the use of response cards during a fourth-grade social studies lecture to increase student participation. Hand raising was compared to write-on response cards in an ABAB reversal design. Dependent variables included teacher presentation rate, number of student responses, accuracy of student responses, and daily quiz scores. During large-group instruction, six students were picked to represent the overall skills of the class and only their responses were recorded. Results indicate that students were given more opportunities to respond to teacher questions, which resulted in higher rates of participation during the condition using response cards. The results also show that 19 of the 20 students increased quiz scores from baseline to intervention during the response cards conditions. Limitations of the study included the number, age, and skill levels of the students who participated, the curriculum area involved, and the relatively short duration of the study. Also, no data were obtained concerning the degree to which improvements in academic performance might be maintained over time. Future research should examine whether
response card use can produce higher scores on quizzes and cumulative tests administered at a later date.

Another study evaluated the effects of response cards on student participation and academic achievement during fifth-grade science instruction (Gardener et al., 1994). The study replicated the findings of Narayan et al. (1990) and extended the delay between instruction and testing to measure a maintained effect on academic achievement using an ABAB reversal design. The teacher nominated five students to represent the class. Dependent variables measured during the study included teacher presentation rate, number and accuracy of student responses, next-day quiz scores, and bi-weekly review test scores. In addition, students’ opinions concerning the two response methods were obtained in a two-question interview at the conclusion of the study. Results indicated that all 22 students scored higher rates of student responding in the response card conditions as compared to the hand-raising condition. The delayed quiz and test scores also increased from baseline to treatment conditions. Future research must demonstrate that classroom teachers can effectively use response cards with their students.

In a study by Christle and Schuster (2003), the effects of using response cards on student participation, academic achievement, and on-
task behavior during fourth-grade math instruction were evaluated. The design used was an ABA design. During the A condition, hand raising was in effect and during the B condition, response cards were used. Data were collected on five students who represented the class in general level of participation, academic skills, and on-task behavior. Dependent variables included the number of student response opportunities, the number of student responses, students’ quiz scores, and the percentage of intervals in which students were on-task. Event recording was used for the number of response opportunities and student responses. Permanent product recording was used for the weekly quiz scores reported as correct. Results indicated that response rates were effective in increasing participation, academic achievements and on-task behavior. Due to scheduling conflicts, an ABA design was used rather than an ABAB. This design is a weak demonstration of experimental control because it fails to replicate the intervention phase. Future research should include maintenance probe sessions to determine if the results are either short-term or lasting, and not due to confounding effects. The authors also suggest holding constant the number of questions that the teacher asks in each session to allow for greater internal validity. As the results from single subject research cannot be generalized to large groups, future replications should be conducted to
determine whether similar results would be obtained from the same students across different content areas or with different teachers.

Lambert and colleagues (2006) evaluated the use of response cards in two fourth-grade math classrooms. Using an ABAB reversal design, they measured nine students’ disruptive behavior and responding when using response cards. Researchers used a more conservative 15 s partial interval recording of disruptive behaviors. Results reflected decreases in disruptions and increases in responding when response cards were implemented. At the end of the study, both the teachers and the target students answered a questionnaire containing eight open-ended questions. The questionnaires revealed teachers’ opinions about the use of response cards having a positive effect on students, and that the procedures were easy to administer. Students enjoyed using the response cards and felt it helped them learn. Limitations of the study included a Functional Behavioral Assessment (FBA) not being conducted prior to implementation of the interventions for this study. Thus, it may be assumed that the function of the disruptive behavior was connected to the students’ need for stimulation. Due to the varying difficulty of the content materials across sessions, the difficulty of the teacher-presented questions varied. A major methodological flaw related to the researchers possibly missing important data because
they had to check their wristwatches to mark the 15 s intervals for disruptive behavior. The use of video or audio tape recording could address this issue. Future research should reduce the duration of the partial interval observations from 10 s to 5 s. This would allow for more observation intervals. Future studies should also extend the investigation to include students at different levels of both academic and social levels. The authors also suggested not only keeping the difficulty of questions more consistent across sessions, but also evaluating how different types of questions may contribute to student response rates.

Next, a study evaluated the effects of using response cards on five low-participating students during English vocabulary instruction in a fifth-grade inner-city classroom (Munro & Stephenson, 2009). A reversal ABAB design was used to evaluate the effects of response cards on the rate of teacher questions and feedback, the percentage of student-initiated responses, and test scores. Results indicated that the teacher provided the students with a greater amount of feedback during the response card condition than in the hand-raising condition. A reason for this outcome may be that in the response card condition, the teacher had more information about errors across all students and may have been in a better position to provide informed feedback. As with other studies on the effects of response
cards, results reflected an increase in student responding. There were several limitations present in the study. First, a pretest was not administered to measure previously known vocabulary. Although test scores did improve with response cards, the scores were quite low at barely 80 percent. This suggests that the student did not master the target vocabulary words. Future research should examine the accuracy as well as the frequency of responding to ensure mastery of academic material.

Skibó et al. (2011) combined a system of least prompts with the use of response cards to increase mathematical knowledge and number identification in three elementary school students with severe intellectual disabilities. A multiple probe across participants design was used to measure the number of correct responses using response cards to answer mathematics questions on number identification for numerals 1 to 5. Maintenance checks were conducted two weeks after the intervention concluded to demonstrate that the skill level was sustained. This study is one of the few to look at response cards with students who have severe disabilities. Results show correct responses increasing after intervention. All three participants also retained their correct responding during the maintenance phase. The teachers completed a questionnaire to measure social validity. Results indicated that all teachers strongly agreed the
strategy improved the participants’ ability to answer without having a verbal response. Both teachers indicated that they would use this teaching strategy for other students in their class. A limitation to the study included a focus on a limited amount of numerals being taught. This led to students’ satiation to the exposure of the numerals after a period of time and resulted in a decreased interest in the activity. Future research is needed to look at the effects of this teaching strategy on additional numerals being presented to students and in different content areas. Another limitation of the study was the limited number of students. Additional replications will be necessary. Future research is needed that allows for generalization of the targeted skills to other instructors, settings, or types of response cards. This study could also be replicated using students with severe disabilities in higher grades levels than elementary school.

Armendariz and Umbreyt (1999) examined the effects of response cards on disruptive behavior in a general education classroom during a mathematics lecture. During baseline, one student volunteer would be called on to answer. If the student gave an incorrect answer the teacher would call on other students until the correct answer was provided. For the response card intervention the authors chose to use write-on response cards to accommodate for the wide variation of possible answers and
questions presented in the math lecture. All students received a response card and all were required to respond. Using an ABA reversal design, data were collected using a time sampling recording system. Results indicated that every student had a considerably lower percentage of intervals with disruptive behavior during the response card intervention. The mean decrease in disruptive behavior for the whole class was 86%. Follow-up data conducted 4 weeks after intervention showed that students resumed a high rate of disruptive behavior once the teacher returned to the traditional approach, or baseline conditions. Almost all of the students expressed a preference for the response cards and even worked into their recess period. The authors concluded that active student responding provides an alternative activity to disruptive behavior. For example, a student who taps on the desk disruptively cannot do so if there is a response card in their hand. Limitations to this study include the disruptive behaviors not being severe or aggressive, the class size being relatively small, and teacher satisfaction of the response cards was not assessed. The teacher in this study did not continue the implementation of response cards. Future researchers should consider assessing teacher satisfaction to determine the validity of response cards during instruction.

Marmolejo et al. (2004) evaluated the effects of response cards on
27 students’ quiz scores and participation in an upper division undergraduate college course. Dependent variables measured during the study included scores on a post lecture quiz and the number of incidents of student participation per class meeting. At the end of each lecture, students were provided with an 8- to 10-question quiz that assessed their knowledge of the material presented in that day’s lecture. Results reflected that response cards increased both quiz scores and student participation. Marmolejo et al (2004) expanded the use of response cards to a new type of college course and population. At the conclusion of the study, all students completed a questionnaire designed to measure the social validity of the response card procedure. Most students reported that the response cards improved their attention, and suggested that more professors should use response cards in their lectures. A limitation to Marmolejo and colleagues (2004) is that the difference in mean scores across the different conditions was not very large, and there was some overlap in data across phases. This restricts the extent to which conclusions can be made about the relative effectiveness of response cards. Future research should investigate the optimal number of response card questions because too many questions may actually interfere with student performance.
Cavanaugh and colleagues (1996) used an alternating treatments design in a ninth-grade science class with 23 students. Eight of these students were identified with learning disabilities, EBD, and mental retardation. Next-day quizzes and weekly tests were used to compare an “active review” and a “passive review.” Both reviews contained 12 content review questions. The passive review involved students looking and listening to the teacher. The response card condition (active review) had statements presented with a fill-in-the-blank format. Three different quiz formats were assessed. Format one had 12 review questions read one time each during the review sessions and format two had 12 review questions read twice each during the review. Format three had 6 review questions read twice each using response cards and 6 review questions read twice using passive review. For all response card questions, next-day quiz and weekly test scores were higher during the response card (active review) condition. A limitation of this study was that students were not pretested prior to the study so it is not possible to determine if all the material was new to all the students. Specifically, prior knowledge may account for some of the increased scores.

George (2010) conducted a crossover design with 22 middle school students with EBD. The study took place in a self-contained social studies
classroom with five special education teachers. Dependent variables included on task behavior, attempted responses, correct responses, chapter post-test scores, and student satisfaction. Results show that students scored slightly higher with on task behavior when using response cards ($M = 93$ percent) compared to using hand raising ($M = 84$ percent). Attempted and correct responses also increased during response card use. Chapter post-test scores increased from a mean of 66.27 to 75.82. During the response card condition, the students in this study increased participation by making more responses. In addition, the responses were correct more often, and 88% of the students had increased quiz scores. A limitation to George (2010) included post-test scores not being significantly different from pre-test scores. Future research may suggest the duration of the study being extended to evaluate the long-term effects and examine the rates of teacher praise when using the response cards versus the hand raising condition.
Conclusions and Study Objectives

Response card use, when compared to hand raising during academic instruction, resulted in increased student participation, academic performance, and time on-task with decreases in disruptive behavior. The social impact on teachers and students is also positive. Suggestions used in my study included the effects of response card use on cumulative tests administered at a later date (Narayan et al., 1990; George, 2010) and research that generalizes the targeted skills to other settings and populations (Christle & Schuster, 2003; Skibo et al., 2011). The goal of the proposed study was to evaluate the long-term effects on response card use while increasing students’ engagement and academic performance. Little research has examined response cards in the middle school population. This extension served to generalize the results to age groups for which there are few ASR studies.

Method

Participants and Setting

The participants for the study were selected from an alternative learning school for students who can not attend a public school due to different exceptionalities. All of these students had Individualized Education Plans (IEPs), Behavior Intervention Plans (BIPs) and are classified as at-
risk students with emotional and behavioral disorders (EBD). At-risk can be defined as being at risk for failing academically resulting in the dropping out of school. In addition to having a low-income population (81% free and reduced lunch), the school also has very low academic achievement scores. The classroom used for this study was a Math class; the classroom consisted of eight to ten middle school (grades 6 to 8) students ranging in age from 13-16 years old. Students sat in desks organized in rows and columns. Two different teachers used teacher-directed instruction (i.e., lecture) at the front of the classroom to present essential course material directly to the students. A second teacher joined the class during week 6 of the study and taught for five weeks; this second teacher left unexpectedly in week 11 resulting in the initial teacher returning to the class. Each class session lasted approximately 50 min and the teachers conducted their lessons as planned. The lesson consisted of the following activities: (a) quick pretest to assess students’ prior knowledge of new material, (b) presenting new material, (c) guided practice over new material, (d) group work or independent practice, and (e) a review session covering the new material.
Materials

Materials included 10 response cards (23 cm x 15 cm dry-erase white boards), dry erase markers (Expo© brand), and a paper towel. Materials were presented to students by the teacher or teacher assistant at the beginning of each review session and then collected at the end of the review session.

Experimental Design

An alternating treatments design with baseline was used to evaluate the effects of response cards on student engagement. To assess the long-term effects of response cards on academic performance a pretest-posttest control group design was used. Hand raising and response card use were alternated weekly (i.e., odd weeks consisted of the hand raising condition and even weeks consisted of the response card condition for the experimental group). The researcher collected data on a control group, which received no intervention; this data helped evaluate the effect(s) of the intervention on academic performance. This study was conducted over a full academic year with data collected at the beginning of the year, end of the first semester, and the middle of the second semester to observe the long-term effects of using response cards. The educational materials presented to the two groups were identical, but participants in the
experimental group were slightly younger (see Table 1 for demographics). Across phases, absences in the control group were an average of 1.5 (range: 0-4) students absent on end of week quiz days and an average of 1.1 (range: 0-3) students absent in the experimental control group. The experimental group had an average of 8.6 (range: 7-10) students enrolled in the math class with 12.5% (range: 0%-37.5%) absent on average during end of week quizzes. The control group had an average of 9.3 (range: 7-11) students and 16.5% (range: 0%-40%) were absent on average during end of week quizzes.

**Dependent Variables and Inter-observer Agreement (IOA)**

**Student engagement.** Student engagement, also referred to as participation, was operationally defined as the student responding to a question asked by the teacher by either calling out a response, raising a hand, or using the response card. The average number of attempted responses per student per review session was calculated on a weekly basis. The total number of questions per review session remained constant ($n = 6$) across all conditions.

IOA data were collected randomly during 33% of sessions, and were evenly distributed across all experimental conditions. IOA was determined by comparing data collected during sessions by the two independent
observers. Agreement was defined as both observers agreeing that a given student attempted a response to a given question. Disagreement was defined as one observer recording that a student attempted a response and the other observer recording that a student did not attempt a response. IOA for student engagement was calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100%.

**End of week quiz scores.** Quizzes were conducted at the end of the week and consisted of approximately 15 to 20 questions or problems, which were not identical to response card questions but were on the same content. End of week quiz scores were collected from end of week quiz scores during half an academic year consisting of one semester (18 weeks). Baseline was weeks 4-6, followed by the alternating treatment design in weeks 7 to 16. Quiz score data were collected starting the fourth week into the first semester as the first three weeks were for reviewing prior material learned. The average percentage of items correct per student on end of week quizzes was collected. All correct responses in both the control group and experimental group were added up separately and divided by the total number of students in each group. This number formed a mean score for each quiz. Accuracy of the scoring of weekly quizzes was assessed by
the researcher who scored unmarked photocopies of each quiz. These photocopies were assigned a number to replace students’ names allowing for anonymity. An item was scored as correct if the answer was the same as the answer on the answer key. Each observer had their own data sheet to record quiz scores (see Appendix D). Agreement was defined as both observers agreeing that a given student answered a given question correctly or incorrectly. Disagreement was defined as one observer recording that a student answered a given question incorrectly and the other observer recording that the same student answered the question correctly. IOA for the end of week quiz scores was calculated using point-by-point agreement, calculated by dividing the total agreements by the agreements plus disagreements and multiplying by 100%. IOA was collected during 100% of quiz sessions.

**Academic performance.** The primary researcher collected academic performance data from average scores on three identical academic tests. The tests included 36 questions and covered all material that was taught throughout the first semester and were used to assess for acquisition and retention of material. The teacher tested students at the beginning of the first semester (Pretest; September), at the end of the first semester (Posttest; December), and at the middle of the second (Retention
test; March). The IOA procedure used for the end of week quiz scores (see above) was also be used to assess the accuracy of scoring on the three tests of academic performance.

**Procedures**

**Baseline.** Throughout the course of the study, classes followed the set procedure described in the setting. Baseline consisted of a typical question and answer format where students were expected to answer the teacher’s questions by either calling out the answer or raising their hands. For example the teacher said, “who knows the answer to this question?” The teacher then provided either brief corrective feedback or praise before moving on to the next item. Any time a student answered a teacher-guided question either by hand raising or calling out was recorded. No feedback or consequences were provided if students did not attempt an answer. This condition was maintained until a stable trend was established.

**Hand raising.** This condition consisted of the typical hand raising method by using a question and answer format where students were expected to raise their hands in response to the teacher’s questions and wait for the teacher to call on them to respond. At the start of each class in this condition and immediately after posing a question, the teacher encouraged the students to answer by raising their hands. For example the
teacher said, “by raising your hand, who knows the answer to this problem?” If the student answered the question correctly, the teacher verified the correct response and provided verbal praise to the student. If the answer was incorrect, the teacher indicated that the answer was incorrect and asked for another volunteer to answer the same question. Only attempted responses in which hand raising was used was recorded. Raised hands had to be held up over the students’ head to be counted. Similar to baseline, no feedback or consequences were provided if students did not attempt an answer. Data for IV integrity were only collected for the first student response to a given question. That is, if the student called upon answered incorrectly, IV integrity was not collected on the second student called upon for that question.

**Response cards.** Prior to the implementation of response cards, the teacher was trained in implementing response cards. Training included a handout that described the procedure, modeling, and role-playing of the correct use of response cards. Students were also trained to use response cards in a practice session prior to the first session of the response card condition. This included examples of proper response card usage (large answers, response cards placed face down to cover answer, response cards held up high enough for teacher and researcher to see answer). Prior
to each lecture, the teacher generated six content questions to be used during the response card condition. Content questions were developed using the teacher’s selected textbook and the Common Core standards already in place at the school. Questions contained a combination of multiple-choice and/or 1-2 word answers. The researcher reviewed questions for quality at least 2 days in advance of the review sessions. The teacher was encouraged to create questions that were consistent with textbook material and were not exact questions previously covered. Appropriate questions were similar to problems covered earlier, but with different numbers. At the start of the review session, the teacher or teacher assistant passed out response cards to each student. The teacher presented a question to the class and then requested that the students respond by writing the answer on their response cards (“Write down your answer”). Students were given 2 min to respond to each question. To prevent cheating, response cards were placed with the answer facing down. After the 2 min, students displayed their cards immediately upon the teacher’s request (“Hold up your answers”), and then awaited teacher feedback. An instructional interval consisted of the question, a pause for student responding, and followed by the teacher’s visual scan of student responses and feedback to the entire class. The teacher then revealed the
answer to the class and praise was given for correct responses. Next, the
teacher provided rationale for the answer on the large whiteboard in front of
the classroom. No feedback or consequences were provided if students did
not attempt an answer. Student engagement with the response cards was
defined as raising the card up with an answer that was appropriate to the
question and was a possible response to the question. Profanity or random
words are examples of inappropriate responses. Non-engagement was not
raising the response card up, holding an inappropriate response (see
definition above), or raising up a response card without an answer.

Data Collection

To collect data on student engagement, the researcher was the
primary observer and sat in the front corner of the room facing the students,
ensuring that all student responses could be viewed and recorded. The
teacher was the secondary observer and presented the lecture at the front
of the classroom facing the students. Both observers scored their
observations using their own data sheets (see Appendix C). The researcher
signaled to the teacher the completion of recording for each question.
Students were aware that the researcher was observing the class. Students
were told the reason for observation was to see how well a teaching aid
worked. Data were collected using a paper and pencil format whereby data collectors recorded the frequency of attempted students responses.

**Independent Variable Integrity**

The primary researcher sat near the teacher to measure the teacher’s recording of student responses. This was used to assess IV integrity of the teacher’s behavior in each condition as well as recording student response and agreement data (see Appendix E). At the beginning of each week, the researcher provided the teacher and / or teacher assistant with the needed materials. To prevent response cards being used in the hand raising condition, the researcher removed the response cards during hand raising weeks.

**Social Validity**

To measure participant satisfaction, the initial teacher and students completed a questionnaire (See Appendix F). On the last day of data collection, the researcher administered the student questionnaire to the class. Using a 5-point Likert scale, students rated in general how effective they perceived using response cards compared to hand raising was on class participation, how effective they perceived using response cards compared to hand raising was on quiz scores, if they would like to continue using response cards, and if they would want to use response cards in
other classes. The first teacher that was with the class for 13 weeks was asked to complete a questionnaire on the last day of intervention at the same time that students were completing their questionnaire. The teacher questionnaire consisted of generally rating on a 5-point Likert scale the effectiveness of response cards on class participation and quiz scores, the opportunity to provide immediate feedback while using response cards, how easy the teacher felt response cards were to implement, and if the teacher would continue to use response cards in the future.

Results

Inter-Observer Agreement

Student engagement. The second observer conducted IOA checks to monitor the reliability of the primary observer's coding of student engagement. Reliability checks were conducted during at least 33% of sessions for each of the study's conditions. IOA data were collected in 13 of the 35 sessions of the study (37.1%). Agreement on individual students' hand raising was 97.9% over the course of the study.

End of week quiz scores and academic performance. The primary observer independently graded student quiz scores and academic tests. IOA data were collected for all 13 of the quiz scores over the course of the study (100% of sessions). Point-by-point agreement for scoring of
individual items on quizzes was 100%. IOA data were collected for all 3 of
the academic test scores (100% of sessions). The same method for
calculating quiz scores was used for academic tests with IOA of 100%.

**IV integrity**

IV integrity checks were conducted during 13 of the 35 sessions of
the study for teacher's implementation of procedures to promote student
engagement. Immediately after the session, the researcher would talk to the
teacher regarding his or her use of the experimental procedures. The two
times integrity fell below 80%, the researcher provided positive and
corrective feedback before the next experimental session. Both times IV
that integrity fell below 80% were with the secondary teacher during the
response card condition. Modeling and rehearsal were also utilized. IV
integrity was calculated by dividing the number of steps performed correctly
by the total number of steps and then multiplying the quotient by 100. IV
integrity averaged 90.7% (range: 72.2%-100%) over the course of the
study.

**Student Engagement**

Student engagement was measured by attempted responses per
student to six teacher-posed questions during daily review sessions. The
implementation of RC resulted in improved student engagement during
daily review sessions (see Figure 1). Students attempted more responses in all RC weeks than in HR and baseline weeks. During baseline, students attempted a mean number of 3.0 responses (range: 2.7 - 3.2), which means that students attempted on average to respond to 50% of questions. During HR sessions, students attempted 2.2 responses or 37% on average (range: 1.9 - 2.7), compared to 5.8 or 97% on average during RC sessions (range: 5.3 - 6.0).

**End of Week Quiz Scores**

In the control group, students answered an average of 29% questions correctly (range: 12.2% - 56.5%) on end of week quiz scores over the course of the study. In the experimental group, students answered an average of 60% (range: 48.8% - 83.3%) questions correctly during baseline. During HR sessions, students in the experimental group answered an average of 64% (range: 48.4% – 83.3%) questions correctly, compared to 75% (range: 70.0% – 85.5%) during RC sessions (see Figure 2). The percentage of questions answered correctly on end of week quizzes was 11.2 percentage points higher during RC than during HR. Table 2 shows each quiz score for both the control and experimental group across all conditions.
**Academic Performance**

On the academic pre-test, students \((n = 7)\) in the control group answered an average of 13% of questions correctly (range: 0.0% - 32.4%) and students \((n = 8)\) in the experimental group answered an average of 29% (range: 17.6% - 50.0%) questions correctly. On the post-test, students \((n = 6)\) in the control group answered an average of 26.5% questions correctly (range: 0.0% - 76.5%) while students \((n = 8)\) in the experimental group answered an average of 69.5% questions correctly (range: 20.6% - 97.1%). On the retention test, control group students \((n = 5)\) scored an average of 34.7% questions correctly (range: 0% - 79.4%) and experimental group students \((n = 5)\) scored an average of 59.4% questions correctly (range: 20.6 – 94.1%). See Figure 3 for a graphic display. The percentage of questions answered correctly on academic tests was 10.1 percentage points lower during post-test than during retention test for the experimental group. Table 3a shows the average academic test scores for both the control and experimental group across all conditions. Table 3b shows the average academic tests for the students \((n = 5)\) that took all three academic tests.
Social Validity
Results from the social validity questionnaires (see Table 4) from students ($n = 8$) revealed students were on average neutral or slightly positive in their ratings of RC ($M = 3.7$), but were neutral in their preference for RC over HR ($M = 3.1$). All other student ratings of social validity were fairly neutral on average (range: 2.9-3.3).

The teacher rated the overall use of response cards highly favorably ($M = 4.4$). The teacher preferred using the response cards to hand raising during lectures, and strongly agreed that response cards provided immediate feedback.

Discussion
Response cards effectively increased middle school students’ engagement and academic performance as compared to a more traditional response approach (i.e., hand raising), as all students responded to more questions during the RC condition. Student engagement in HR was surprisingly lower than engagement in baseline. This may be related, in part or whole, to the removal of the calling out answers option in HR. That is, students may prefer calling out answers than to HR. RC also provided immediate feedback to the teacher (Christle & Schuster, 2003; Heward, 1994; Munro & Stephenson, 2009).
Students in the experimental group had higher quiz scores than the control group whether they were in the HR or RC condition. Students in the RC condition had higher quiz scores compared to students how raised their hand. Both HR and RC conditions had upward trends in weeks 13-16. The upward trend noted across both the HR and RC conditions (i.e., starting in week 13) may be related to the change in math teachers described above. Students in the experimental group had higher test scores than the control group throughout all phases. Students in the experimental group did retain some academic material over time, which may be attributed to the use of RC. Specifically, student scores on the retention test did not drop below pre-test scores. The average score may have been higher as two students that scored high on the posttest were absent during the retention test. A slight upward trend is seen in the control group on academic tests. This could be due to two low-scoring posttest students being absent the day of the retention test. Another possibility is that the control group may have learned the material at a different trajectory as compared to the experimental group.

Student scores on the social validity questionnaire were comparable across both experimental conditions (i.e., both RC and HR scores were fairly neutral). Students moderately agreed that they answered more
questions with RC than HR and were neutral in using them in other classes. These social validity results are not as positive as prior studies, perhaps due to the characteristics inherent in many children diagnosed with EBD (e.g., noncompliance; Gardner et al., 1994; Narayan et al., 1990). The teacher was highly favorable to using RC compared to HR during lecture, enjoyed receiving immediate feedback with RC, agreed RC were easy to implement and would like to use RC in future classes. The teacher also reported he would be likely to use RC after this study concluded.

Student engagement in HR was surprisingly lower than engagement in baseline. This could be because of the removal of the calling out answers option in HR. Students may prefer calling out answers than the increased response effort required to raise their hand. RC also provided immediate feedback to the teacher (Heward, 1994; Christle & Schuster, 2003; Munro & Stephenson, 2009). On several occasions, the teacher indicated he presumed the students were grasping the material; however, the visual depictions associated with RC contradicted this assumption. Additionally, this feedback allowed the teacher to modify his instruction by spending more time on weak areas and prompting correct responses.

This study adds to the ASR literature by further showing that RC is an effective strategy for increasing student engagement and academic
performance. While few studies have focused primarily on students who have EBD (Armendariz & Umbreit, 1999; Christle & Schuster, 2003), this study demonstrates an effective teaching strategy for working with this population. When using RC, the teacher engaged students during lectures and increased their academic performance. By collecting data on pre-test, post-test, and retention test scores over 6 months, the long term effects of RC could be evaluated, which other studies had not done (Cavanaugh et al., 1996; Munro & Stephenson, 2009; Narayan et al., 1990). Comparing students exposed to HR and RC to a control group was also a novel feature of this study that allowed for greater experimental control. This study also held constant the number of questions that the teacher asked in each session (Christle & Schuster, 2003). Holding the number of questions constant allowed for greater uniformity across experimental conditions and was not done in other studies.

There are several limitations to this study. First, the number of participants in both groups was small with an average of eight students. Student absences greatly affected the continuity of data collected. Absences from school and students reassigned to other classes due to disciplinary issues were common occurrences. Replication of this study with more students is warranted to provide more generizable evidence on
whether RC are more effective than HR during EBD inclusion classes. Second, in terms of group comparisons, the two groups were not equivalent or randomly selected, which resulted in a quasi-experimental design. The control group consisted of a slightly older population with more 8th graders than the experimental group. Some students in the control group had repeated grades due to problem behaviors, poor grades, and truancy. Future research should use random assignment of students for greater experimental control. Third, the difficulty of the material may have affected the academic performance of the students. The researcher noticed some students would still be working on the assigned question when the teacher requested the students to present their answers, while others were finished and waiting to respond. A limitation to RC is that they are not individualized for each student. Placing students into peer-guided groups that consist of similar academic levels could ameliorate such student weaknesses. Fourth, there were different classroom management and instructional strategies used by the two teachers. It is possible that some teacher behavior was not accounted for or controlled in the study that could have affected the students’ behavior during instruction. IV integrity checks were conducted for teachers’ compliance on implementing the experimental conditions not the effectiveness of their instruction. For example, the new teacher steered
away from the curriculum plan for three weeks. This may have affected quiz score data in weeks 7, 10 and 11, possibility, resulting in quiz scores that were lower than average. Future researchers may want to better control classroom management strategies by using the same teacher throughout the study and conducting IV integrity on lesson instruction.

In conclusion, behavioral, academic, and social interventions for students with EBD are critical. Due to the high number of students at risk for dropping out of school, it is important to teach these students in a way that increases their participation and academic performance levels. The findings of this study indicate RC are an efficient teaching method for use with students with EBD. All of the students included in the study participated more in instruction during the RC condition, which in turn leaves less time to engage in less disruptive behavior. RC are also inexpensive to create and are flexible to be used in a variety of academic areas. Write-on RC can be individualized for a number of academic subjects (e.g., science, math, language arts) due to the nature of writing out the answer. The price of purchasing RC and markers was approximately $30 for all the materials needed. This study extends previous research on RC by evaluating the long-term effects of RC on academic performance and providing more research for a population (i.e., middle school students with EBD) where it
has been sparse. In this summary, this study provides support for the use of RC in EBD classrooms due to its practicality, convenience, and academic outcomes.
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Skibo, H., Mims, P., & Spooner, F. (2011). Teaching number identification to students
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and Developmental Disabilities, 46*, 124-133.
### Appendix A

#### Tables

**Table 1**

**Student demographics**

<table>
<thead>
<tr>
<th>Group</th>
<th># Of 7&lt;sup&gt;th&lt;/sup&gt; graders</th>
<th># Of 8&lt;sup&gt;th&lt;/sup&gt; graders</th>
<th>Repeated 7&lt;sup&gt;th&lt;/sup&gt; graders</th>
<th>Repeated 8&lt;sup&gt;th&lt;/sup&gt; graders</th>
<th>Age Range</th>
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<td>Experimental</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>13 - 16</td>
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<td>(n = 10)</td>
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<td></td>
<td></td>
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<tr>
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<td>1</td>
<td>7</td>
<td>0</td>
<td>3</td>
<td>14 - 17</td>
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<td>(n = 8)</td>
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Table 2

*End of Week Quiz Percentage Correct Scores*

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<th>Quiz 6</th>
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<td>Mean</td>
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<tr>
<td>Mean</td>
<td>58.5</td>
<td>55.0</td>
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<td>59.7</td>
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<td>Range</td>
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<td><strong>Intervention</strong></td>
<td>Quiz 7</td>
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<td>Quiz 9</td>
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<td>Mean</td>
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<td>90</td>
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*Note.* HR represents hand raising and RC represents response cards.
Table 3a

*Academic Tests Percentage Correct Scores Across Groups*

<table>
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<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
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<tr>
<td>Pre</td>
<td>8</td>
<td>29.0</td>
<td>13.5</td>
<td>7</td>
<td>12.6</td>
<td>13.9</td>
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<tr>
<td>Post</td>
<td>8</td>
<td>69.5</td>
<td>27.2</td>
<td>6</td>
<td>26.5</td>
<td>25.2</td>
</tr>
<tr>
<td>Retention</td>
<td>5</td>
<td>59.4</td>
<td>34.9</td>
<td>5</td>
<td>34.7</td>
<td>28.8</td>
</tr>
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</table>
Table 3b

*Academic Tests Percentage Correct Scores Across Groups: Student who took all three academic tests*

<table>
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<tr>
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<th>Control</th>
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</thead>
<tbody>
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<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
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<tr>
<td>Pre</td>
<td>5</td>
<td>23.8</td>
<td>7.3</td>
<td>5</td>
<td>8.2</td>
<td>12.7</td>
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<tr>
<td>Post</td>
<td>5</td>
<td>63.6</td>
<td>31.8</td>
<td>5</td>
<td>27.2</td>
<td>27.2</td>
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<tr>
<td>Retention</td>
<td>5</td>
<td>59.6</td>
<td>34.6</td>
<td>5</td>
<td>34.6</td>
<td>28.6</td>
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</table>
Table 4

*Mean Social Validity Scores per Question*

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student (n = 8) Questions</strong></td>
<td></td>
</tr>
<tr>
<td>I liked using the response cards more than raising my hand.</td>
<td>3.1</td>
</tr>
<tr>
<td>I answered more questions with the response cards than when my teacher asked me to raise my hand.</td>
<td>3.3</td>
</tr>
<tr>
<td>I was very well prepared for the quiz after using response cards.</td>
<td>2.9</td>
</tr>
<tr>
<td>I was very well prepared for the quiz when I answered the review questions by raising my hand.</td>
<td>3.3</td>
</tr>
<tr>
<td>I would like to use response cards in my other classes.</td>
<td>3.0</td>
</tr>
<tr>
<td>Overall, I liked the response cards.</td>
<td>3.7</td>
</tr>
<tr>
<td><strong>Teacher (n = 1) Questions</strong></td>
<td></td>
</tr>
<tr>
<td>I prefer using response cards compared to hand raising in my lecture.</td>
<td>5</td>
</tr>
<tr>
<td>With response cards, I received immediate feedback on how all students were grasping the material.</td>
<td>5</td>
</tr>
<tr>
<td>Response cards were easy to implement.</td>
<td>4</td>
</tr>
<tr>
<td>I would like to use response cards in the future in other classes.</td>
<td>4</td>
</tr>
<tr>
<td>Overall, I enjoyed using response cards.</td>
<td>4</td>
</tr>
</tbody>
</table>

*Note.* Ratings based on Likert-type scale ranging from 1 (strongly disagree) 3 (neutral) to 5 (strongly agree).
Appendix B

Figures

Figure 1

Student Engagement. HR stands for "Hand Raising", RC stands for "Response Cards".
Figure 2

End of Week Quiz Scores
Figure 3

*Academic Performance Tests Percentage Correct Scores Across Groups*

![Chart showing academic performance tests percentage correct scores across groups. The x-axis represents Pre-Test, Post-Test, and Retention Test. The y-axis represents the average test score (percentage correct). The chart compares the Experimental Group (filled bars) and Control Group (open bars).]
Appendix D

Data Summary Sheets

DATA SUMMARY SHEET – END OF WEEK QUIZ SCORES
Observer: ___________________ Date: ___________________ Week #: ____________
Condition:  BL  HR  RC  Group: Experimental  Control

Directions: CORRECT answers – mark with an “O”  INCORRECT answers – mark with an “X”
Leave blank for questions not applicable.  Questions not answered are marked incorrect.

<table>
<thead>
<tr>
<th>Quiz 1</th>
<th>Quiz 2</th>
<th>Quiz 3</th>
<th>Quiz 4</th>
<th>Quiz 5</th>
<th>Quiz 6</th>
<th>Quiz 7</th>
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Total # Correct / Total Possible
Quiz 1 __________ Quiz 2 __________ Quiz 3 __________ Quiz 4 __________ Quiz 5 __________
Quiz 6 __________ Quiz 7 __________ Quiz 8 __________ Quiz 9 __________ Quiz 10 __________
DATA SUMMARY SHEET – TEST SCORES

Observer: ___________________________ Date: ________________ Week #: ____________

Group: Experimental  Control

Directions: CORRECT answers – mark with an “O”  INCORRECT answers – mark with an “X”
Leave blank for questions not applicable. Questions not answered are marked incorrect.

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Total # Correct / Total Possible

TEST 1 _________  TEST 6 _________
TEST 2 _________  TEST 7 _________
TEST 3 _________  TEST 8 _________
TEST 4 _________  TEST 9 _________
TEST 5 _________  TEST 10 _________
### Appendix E

**Independent Variable Checklist**

#### Baseline Condition

<table>
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<th>Observer _____________________________________</th>
<th>Date ________________</th>
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* Use only for FIRST student called upon to answer for each given question. *

**Question 1**

- Teacher presents question to the class [Yes/No/NA]
- Teacher asks students for the answer (Who knows the answer to this question?) [Yes/No/NA]
- Teacher asks students for the answer (By a show of hands) [Yes/No/NA]
- Teacher selects student that has called out the answer or has hand raised [Yes/No/NA]
- If answer was CORRECT, teacher restates correct answer + feedback [Yes/No/NA]
- If answer was INCORRECT, teacher asks for more volunteers [Yes/No/NA]

**Question 2**

- Teacher presents question to the class [Yes/No/NA]
- Teacher asks students for the answer (Who knows the answer to this question?) [Yes/No/NA]
- Teacher asks students for the answer (By a show of hands) [Yes/No/NA]
- Teacher selects student that has called out the answer or has hand raised [Yes/No/NA]
- If answer was CORRECT, teacher restates correct answer + feedback [Yes/No/NA]
- If answer was INCORRECT, teacher asks for more volunteers [Yes/No/NA]

**Question 3**

- Teacher presents question to the class [Yes/No/NA]
- Teacher asks students for the answer (Who knows the answer to this question?) [Yes/No/NA]
- Teacher asks students for the answer (By a show of hands) [Yes/No/NA]
- Teacher selects student that has called out the answer or has hand raised [Yes/No/NA]
- If answer was CORRECT, teacher restates correct answer + feedback [Yes/No/NA]
- If answer was INCORRECT, teacher asks for more volunteers [Yes/No/NA]

**Question 4**

- Teacher presents question to the class [Yes/No/NA]
- Teacher asks students for the answer (Who knows the answer to this question?) [Yes/No/NA]
- Teacher asks students for the answer (By a show of hands) [Yes/No/NA]
- Teacher selects student that has called out the answer or has hand raised [Yes/No/NA]
- If answer was CORRECT, teacher restates correct answer + feedback [Yes/No/NA]
- If answer was INCORRECT, teacher asks for more volunteers [Yes/No/NA]

**Question 5**

- Teacher presents question to the class [Yes/No/NA]
- Teacher asks students for the answer (Who knows the answer to this question?) [Yes/No/NA]
- Teacher asks students for the answer (By a show of hands) [Yes/No/NA]
Hand Raising Condition

Observer ___________________________________________ Date ____________

* Use only for FIRST student called upon to answer for each given question. *

Question 1
• Teacher presents question to the class Yes No
• Teacher encourages students to raise their hand to answer Yes No
• Teacher calls on student whose hand is raised Yes No
• If answer was CORRECT, teacher restates correct answer + feedback Yes No N/A
• If answer was INCORRECT, teacher asks for more volunteers Yes No N/A

Question 2
• Teacher presents question to the class Yes No
• Teacher encourages students to raise their hand to answer Yes No
• Teacher calls on student whose hand is raised Yes No
• If answer was CORRECT, teacher restates correct answer + feedback Yes No N/A
• If answer was INCORRECT, teacher asks for more volunteers Yes No N/A

Question 3
• Teacher presents question to the class Yes No
• Teacher encourages students to raise their hand to answer Yes No
• Teacher calls on student whose hand is raised Yes No
• If answer was CORRECT, teacher restates correct answer + feedback Yes No N/A
• If answer was INCORRECT, teacher asks for more volunteers Yes No N/A

Question 4
• Teacher presents question to the class Yes No
• Teacher encourages students to raise their hand to answer Yes No
• Teacher calls on student whose hand is raised Yes No
• If answer was CORRECT, teacher restates correct answer + feedback Yes No N/A
• If answer was INCORRECT, teacher asks for more volunteers Yes No N/A

Question 5
• Teacher presents question to the class Yes No
• Teacher encourages students to raise their hand to answer Yes No
• Teacher calls on student whose hand is raised Yes No
• If answer was CORRECT, teacher restates correct answer + feedback Yes No N/A
• If answer was INCORRECT, teacher asks for more volunteers Yes No N/A
## Response Card Condition

Observer ___________________________ Date ___________

### Question 1
- Teacher presents question to the class: Yes No
- Teacher provides adequate wait time for students to use RC (at least 2m): Yes No
- Teacher requests students to hold up their cards: Yes No
- Teacher reveals answer to the class: Yes No
- Teacher provides praise for correct responses: Yes No
- Teacher instructs students to fix their answers to the problem and provides rationale for the answer on PowerPoint: Yes No

### Question 2
- Teacher presents question to the class: Yes No
- Teacher provides adequate wait time for students to use RC (at least 2m): Yes No
- Teacher requests students to hold up their cards: Yes No
- Teacher reveals answer to the class: Yes No
- Teacher provides praise for correct responses: Yes No
- Teacher instructs students to fix their answers to the problem and provides rationale for the answer on PowerPoint: Yes No

### Question 3
- Teacher presents question to the class: Yes No
- Teacher provides adequate wait time for students to use RC (at least 2m): Yes No
- Teacher requests students to hold up their cards: Yes No
- Teacher reveals answer to the class: Yes No
- Teacher provides praise for correct responses: Yes No
- Teacher instructs students to fix their answers to the problem and provides rationale for the answer on PowerPoint: Yes No

### Question 4
- Teacher presents question to the class: Yes No
- Teacher provides adequate wait time for students to use RC (at least 2m): Yes No
- Teacher requests students to hold up their cards: Yes No
- Teacher reveals answer to the class: Yes No
- Teacher provides praise for correct responses: Yes No
- Teacher instructs students to fix their answers to the problem and provides rationale for the answer on PowerPoint: Yes No
Appendix F

Social Validity Questionnaire

Response Card Survey

Instructions: Check the answer that best represents your opinion for each question.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
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Question #1
I prefer using response cards compared to hand raising in my lecture.

Question #2
With response cards, I received immediate feedback on how all students were grasping the material.

Question #3
Response cards were easy to implement.

Question #4
I would like to use response cards in the future in other classes.

Question #5
Overall, I enjoyed using response cards.

Any additional comments, suggestions, concerns?
Response Card Survey

Instructions: Check the answer that best represents your opinion for each question.

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

Question #1
I liked using the response cards more than raising my hand.

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

Question #2
I answered more questions with the response cards than when my teacher asked me to raise my hand.

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

Question #3
I was very well prepared for the quiz after using response cards.

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

Question #4
I was very well prepared for the quiz when I answered the review questions by raising my hand.

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

Question #5
I would like to use response cards in my other classes.

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

Question #6
Overall, I liked the response cards.

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