

Increase Engagement and Achievement with Response Cards: Science and Mathematics Inclusion Classes

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Students with academic, social, and emotional disabilities often demonstrate challenging behaviors and struggle to remain focused on the lesson, learn less than their peers, resulting in lower academic achievement. Research has demonstrated that the more actively engaged students are in the lesson, the more they learn, and therefore the more successful they will be academically and behaviorally. Oftentimes, in content intensive courses such as mathematics and the sciences, teachers need strategies to engage the learners in practice and review of the content to determine the need for re-teaching a set of skills before continuing to the next skill set. This study compared the use of response cards to the more traditional method of hand raising in high school classes required for graduation, taught by certified teachers, and inclusive of students with various disabilities and a history of challenging behaviors. The students with disabilities and challenging behaviors in this study are compared with typical, non-disabled peers. An alternating treatment method was used during daily reviews to investigate this interactive strategy to engage the students. The use of response cards increased the number of times all students attempted to participate during the daily class review as well as showing an increase in long term retention of the material reviewed using response cards. In addition, the results of a social validity assessment completed by both students and teachers report various benefits to using response cards as an instructional strategy.

Keywords: Response Cards, Disabilities, Secondary Education, Engagement, Inclusion,

INTRODUCTION

Students with disabilities experience a high school drop out rate of about 31% (NCES; National Center for Educational Statistics, 2018), rarely engage in post-secondary education, often have difficulty finding jobs, and are arrested at the rate of one in eight (Heward, 2013). Employment after high school is most often part time and inconsistent with only 9% of young adults with a disability employed in 2015 (Cullinan & Sabornie, 2004; Jolivette, Stichter, Nelson, Scott, & Liaupsin, 2000; NCES, 2018), and the arrest rate of youth with disabilities is extremely high with one in three

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students with emotional or behavioral disorders (EBD) and 13% of students with disabilities arrested before the age of 18 (Thurlow, Sinclair, & Johnson, 2002; 2018) as evidenced by youth correctional facilities reporting up to 70% of incarcerated youth have been identified with disabilities (Jolivet & Nelson, 2010; Quinn, Rutherford, Leone, Osher, & Poirier, 2005).

Of the 6.7 million students with disabilities taught in public schools, 34% are students with learning disabilities (LD), 14% are students with other health impairments (OHI) to include ADHD, 9% are students with autism (ASD), and 5% are students with EBD. Approximately 80% of these students are taught in general education inclusion classrooms with peers who are non-disabled (NCES, 2018). Commonalities among the characteristics of students with LD, OHI, ASD, and EBD are academic deficits and challenging behaviors (Heward, 2013; Individuals with Disabilities Education Act: IDEA, 2004; Steele, 2007) causing students with these disabilities to struggle throughout their school years academically, behaviorally, and socially (Lane, Carter, Pierson, & Glaeser, 2006; Osborne & Reed, 2011). It is imperative educators find evidence-based instructional practices to increase engagement in the classroom and improve the chance these students with disabilities and challenging behavior will graduate from high school (Druian & Butler, 1987; Finn, 1993). Although a continuum of special education services and placements are mandated by IDEA (2004), the majority of high school students with LD, OHI, ASD, and EBD are in general education classes for the majority of their instructional time (Idol, 2006). Because students with disabilities may be difficult to teach due to challenging behavior, efficient teaching strategies that promote active engagement and increased learning for students with disabilities is critical (Carnahan, Musti-Rao, & Bailey, 2009; Steele, 2007).

Students with Disabilities and Challenging Behaviors

The IDEA definitions of students with LD, OHI, ASD, and EBD differ in criteria, but the characteristics of secondary students with LD, OHI, ASD, and EBD may present similarly with an inability to learn without accommodations, inappropriate and disruptive classroom behaviors, and deficits in social skills and the ability to self-manage (Heward, 2013; IDEA, 2004). Chronic behavior problems, academic deficits, and a lack of social skills all contribute to the difficulty these students may have in the classroom (Nelson, Benner, Lane, & Smith, 2004). Challenging behavior and academic difficulties co-exist (Colvin, 2004; Steele, 2007) and the lack of social skills makes it that much more difficult for students to communicate their needs (Landrum, Tankersley, & Kauffman, 2003). With as much as 13% of high school student enrollment identified as students with disabilities (NCES, 2018), almost all general education teachers have students with disabilities enrolled in their classes. Yet, research on effective teaching strategies in high school general education classes for students with disabilities and/or challenging behaviors is sparse (Griffith, Trout, Hagan, & Harper, 2008; Hodge, Riccomini, Buford, & Herbst, 2006).

Mastropieri and Scruggs (2001) found inclusion is most successful for students when teachers using appropriate curricula implemented effective teaching strategies learned from special education teachers. And one-fourth of the 77% of high school teachers who reported that students with disabilities should be included in

general education classes said students without disabilities learned more when their peers with disabilities were included (Idol, 2006). Using classwide interventions may increase opportunities for student participation, thereby increasing student learning by actively involving all students (Carnahan et al., 2009). Student participation and time on-task is essential to learning (Brophy, 1979); and Iovanne, Dunlap, Huber, and Kincaid (2003) reported a correlation between active student participation and academic achievement. Purposeful classwide implementation of effective teaching strategies to increase participation may be an efficient way to address the needs of students both with and without EBD in general education classrooms (Kern & Clemens, 2007).

Student Engagement

Finn (1993) reported that regardless of social economic status, gender, or ethnicity, the one factor most related to student achievement was student engagement during class. Student engagement is defined as a student focusing on the teacher or materials, responding to and/or asking questions, and completing specific activities and assignments related to the lesson (Moore, 1983). Strategies that increase active engagement directly impact student achievement. Opportunities to respond (OTR) are a form of practice or rehearsal which helps students organize and store information; therefore, asking questions, checking for understanding, and providing and monitoring independent work while offering corrective feedback ensures proper learning and allows for correction of errors before faulty learning becomes established. Haydon, Mancil, and Van Loan (2009) found that increasing student OTR to academic tasks during instruction resulted in almost a 30% increase in on-task behavior as well as a decrease in disruptions in a middle school general education science classroom indicating that increasing student engagement reduced time spent off-task. Sutherland, Adler, and Gunter (2003) found increasing OTR during instruction resulted in twice as many correct responses in a self-contained elementary class for students with LD, OHI, ASD, and E/BD indicating that more time on-task increases learning.

When considering increasing student OTR during instruction, it is important for teachers to understand that students with challenging behaviors experience a more negative school situation than their peers and are unintentionally treated differently by teachers (Sutherland, Lewis-Palmer, Stichter, & Morgan, 2008; Van Acker, & Grant, 1996). Therefore, teachers must become aware of their own behaviors (Mayer, 2001; Van Acker, & Grant, 1996) and intentionally create environments for students with LD, OHI, ASD, and E/BD that maximize both academic and social success by teaching appropriate academic and social skills, providing frequent opportunities for students to use the skills, and reinforcing both the academic skills exhibited by students (Moore-Partin, Robertson, Maggin, Oliver, & Wehby, 2010). All students can learn when educators create positive classroom environments, provide quality education, increase successful learning experiences, and ultimately reduce the sense of alienation students with challenging behaviors experience (Druian & Butler, 1987).

Teachers' use of empirically-based effective teaching strategies such as modeling, checking for understanding, increasing OTR, and providing corrective feedback are antecedents for contingent praise which improves the classroom

environment and increases student participation (Gunter, Jack, DePaepe, Reed, & Harrison, 1994). The interactive relationship between academic deficits and challenging behaviors for students with LD, OHI, ASD, and EBD may be averted when students are supported before the failure cycle begins (Colvin, 2004; Scott et al., 2001). The failure cycle occurs when a student exhibits challenging behaviors to avoid work resulting in removal from the classroom as a means of discipline. This removal from class negatively reinforces the student's behavior by allowing the student to avoid the work and negatively reinforces the teacher's behavior by allowing the teacher to continue without disruption (Colvin, 2004; Scott et al., 2001). Interventions and instructional strategies that allow for immediate feedback and additional instruction reduce problem behaviors associated with skill deficits (Simonsen, Fairbanks, Briesch, Myers, & Sugai, 2008; Sutherland & Wehby, 2001).

Effective instructional strategies implemented as classwide interventions by teachers may maximize student engagement for students with and without disabilities. High school students struggling academically and behaviorally respond to teacher-directed instruction provided at a brisk pace with frequent OTR, followed by immediate corrective feedback and behavior specific praise statements, provided within a predictable pattern of questioning that allows every student to answer an equal number of questions (Brophy, 1979; Landrum et al., 2003). Response cards (RC) are one way for teachers to incorporate each of these strategies into their instruction (Cavanaugh, Heward, & Donelson, 1996; Christle & Schuster, 2003).

Response Cards

Response cards (RC) are preprinted or write-on cards provided to students that allow each student to answer all questions posed by the teacher during instruction (Gardner, Heward, Grossi, 1994; Kellum, Carr, & Dozier, 2001) engaging the learner by requiring students to take an active role during instruction (Adamson & Lewis, 2017; Christle & Schuster, 2003). High school teachers lecture or use direct instruction for 70%-78% of their teaching (Bost & Riccomini, 2006; McKinney & Frazier, 2008) and RC are easily incorporated into lecture-style teaching, providing an opportunity for students to be actively engaged during instruction with minimal change in teaching style (Kellum et al., 2001; Marmolejo et al., 2004). This allows high school teachers to easily interject a question to check for understanding or to review a concept and allowing all students to respond (Adamson & Lewis, 2017; Marmolejo, Wilder, & Bradley, 2004). Incorporating RC into a lecture allows teachers to provide instruction at a brisk pace using continuous formative assessment and allowing the teacher to adjust the lesson during instruction (Kellum et al., 2001; Randolph, 2007). Following student responses teachers immediately provide behavior specific praise statements and/or corrective feedback reinforcing students' participation and providing added instruction by reinforcing the correct response and repeating the correct answer (George, 2010; Moore Partin et al., 2010).

Although much of the research has shown RC to be effective with students at the elementary school level, RC have been found to be effective in a self-contained classroom for middle school students with challenging behaviors (George, 2010) and in high school with students with and without disabilities in general education (Cavanaugh et al., 1996). The results of these studies indicate researchers might

extend the implementation of RC to high school general education classrooms serving students without disabilities and students with disabilities who exhibit challenging behaviors in academic classes.

Using Response Cards in High School Inclusion Classes

Although RC have been shown effective for reducing disruptive behavior (Armendariz & Umbreit, 1999), increasing student engagement (Marmolejo et al., 2004), and increasing student achievement (Christle & Schuster, 2003; George, 2010) from the preschool level (Randolph, 2007) to the college level (Kellum et al., 2001), in general education high school classes (Adamson & Lewis, 2017; Cavanaugh et al., 1996), and self-contained classes for students with EBD (George, 2010); no studies have compared using RC with high school students without disabilities and students with high-incidence disabilities (LD, OHI, ASD, EBD) who exhibit challenging behaviors in general education academic classrooms.

There are over approximately six million students with LD, OHI, ASD, and EBD in public schools spending more than 80% of the school day in general education classrooms (NCES, 2018). Therefore, it is important to investigate instructional strategies such as RC that previous research has indicated effective across other populations to determine if the RC strategy may provide the opportunity for students with disabilities who exhibit challenging behaviors to achieve academically in inclusive high school classes. The purpose of this study was to examine the effect of using RC to actively engage high school students without disabilities and students with disabilities who exhibit challenging behaviors during daily reviews of content instruction. The research questions investigated were: (a) What effect will RC have on student engagement (i.e., attempted responses) for students without disabilities and students with disabilities who exhibit challenging behaviors in high school academic classes; (b) What effect will RC have on academic achievement (i.e., biweekly probes) for students without disabilities and students with disabilities who exhibit challenging behaviors in high school academic classes; (c) Will the effect of RC differ for student engagement and academic achievement between the two groups defined; (d) Will high school students with and without disabilities report RC to be a valuable learning tool for academic courses; and (e) Will high school teachers report RC to be a valuable instructional tool for academic courses?

METHOD

Setting

This study occurred in two high school classes in a suburban school district in the southwestern United States. Both classes were academic content courses required for graduation, taught by certified high school teachers, and inclusive of students with disabilities who had a history of challenging behaviors and current individual behavior intervention plans (BIP). Participants included two teachers, three students with disabilities who had a BIP as part of their Individualized Education Program (IEP), and three students without disabilities. All names in this paper are pseudonyms.

Participants

Students with disabilities. In Class A, two students with a disability and a BIP consented to participate as the 'target students' for the purpose of data collection. Wayne was an 18-year-old male with EBD and Jaime was a 19-year-old male with LD. In Class B, one student with a disability and a BIP assented to participate as a target student. Eric was a 16-year-old male with ASD. These target students with disabilities exhibited off-task and disruptive classroom behaviors that interfered with their learning and the learning of others (i.e., loss of temper, shouting out, arguing, refusal to comply, not completing assignments, and leaving the class). As a result of these behaviors, all three students had a BIP with goals to increase compliance, refrain from blurting out, demonstrate self-control during non-preferred activities, and demonstrate appropriate participation and work completion.

Students without disabilities. The purpose of including a set of target students without a disability was to provide a means of normative comparison (Kazdin, 2011). Normative comparison helps to define whether the behaviors of the students with disabilities and challenging behaviors are distinguishable during daily reviews and on biweekly probes from the behavior of their classmates without disabilities when using RC. These target students were teacher selected and perceived by their teachers to be students with average class participation, passing grades, and no history of misbehaviors; therefore, being socially and academically representative of the class population (Christle & Schuster, 2003; Gardner et al., 1994). In Class A, two teacher selected students consented to participate as the target students for the purpose of data collection. Drew was a 17-year-old male and Kathy was a 17-year-old female. In Class B, one teacher selected student consented to participate as a target student. Kyle was a 16-year-old male.

Teachers. The two teacher participants certified in secondary education in their content area, volunteered to participate, and agreed to attend two training sessions.

Robert taught Class A, Math Models with Applications. This class provided students instructional opportunity to (a) build on their K-8 and Algebra I foundations; (b) expand their understanding of mathematical experiences using algebraic, graphical, and geometric reasoning; (c) recognize patterns and structure; and (d) solve problems from various disciplines. There were 22 students enrolled in this class ranging from ninth through twelfth grades. Robert used teacher-directed instruction (i.e., lecture) to present essential course material directly to the students with students writing notes in composition books. The classroom was set up with desks in rows and columns with students sitting in assigned seats.

Lillian taught Class B, Integrated Physics and Chemistry. This class allowed students to (a) conduct laboratory and field investigations; (b) use scientific methods during investigation; and (c) make informed decisions using critical thinking and scientific problem solving. The class integrated the disciplines of physics and chemistry. There were 18 students enrolled in this class ranging from ninth through eleventh grades. Lillian used teacher-directed instruction (i.e., lecture) to present essential course material directly to the students in combination with one-day labs, independent and small group practice, and regular assessments. The classroom was set up with desks in rows and columns with students sitting in assigned seats.

Dependent Variables

Data were collected for academic variables, which included student engagement measured by attempted responses and academic achievement measured by accuracy of responses on biweekly probes.

Student engagement. Student engagement, often referred to as active participation or time on-task, was defined as attempting to respond to review questions. Attempted responses were defined during the hand raise (HR) condition as any time a student raised a hand indicating a desire to provide a response when the teacher read a review statement with a blank (Kellum et al., 2001) and any time a target student attempted to answer a question when called on by the teacher (i.e., the teacher sometimes heard a student respond without raising his/her hand and would call on the student, encouraging him/her to answer). During the RC condition, an attempted response was counted whenever a target student wrote an academic response related to the current instruction on the card and held it up for the teacher to read. Attempted responses were marked for target students during daily review sessions using event recording and reported as percentages of attempted responses by adding the total number of attempts made, dividing by the total number of student opportunities to respond, and then multiplying by 100%.

Academic achievement. Each class period began with a ten-minute, ten-question quiz to replace the typical 'bell work' on the skills taught and reviewed the previous day. Biweekly probes were used to evaluate the generality of academic achievement effects over time (Kazdin, 2011) and to assess academic retention (Gardner et al., 1994). A 40-item comprehensive probe was given at the conclusion of the baseline phase in each class and again every tenth-class session. The probes assessed student ability to retain material learned during the previous two weeks (Gardner et al., 1994) using three types of items. The items on each probe were chosen to represent items from each condition (i.e., HR and RC) by randomly selecting an equal number of statements from each review/quiz set and including 15 items that were an exact match to quiz statements, 15 items that were rewritten to be similar to quiz statements, and 10 items that were an exact match to review statements that were never used on quizzes. All items were written in the fill-in-the-blank format to prevent differences based on question format. Thirty minutes were provided for students to take the biweekly probe. Biweekly probes were scored as event recording and are reported as percentage correct in each category for each target student. Percentage correct were calculated for each category by adding the total number of correct answers, dividing by the total number of items, then multiplied by 100% for each target student.

Design and Independent Variables

An alternating treatment design (ATD) was used to examine the effect of single student responding using student hand raise (HR) and classwide responding using write-on response cards (RC). Both interventions were implemented during daily review sessions using a randomized schedule prepared in advance (Kazdin, 2011; Marmolejo et al., 2004).

Baseline/hand raise (HR). Beginning on day one in baseline, the teachers concluded the class session with a 10-minute review of the material taught during

that class (Cavanaugh et al., 1996; Shirvani, 2009). The teachers read a statement to the class with a blank towards the end of each statement and then called on one student who had raised a hand (HR) to provide the answer. Teachers were instructed to provide either brief corrective feedback or praise before moving on to the next item. The review process continued through 15 fill-in-the-blank statements with the teachers systematically presenting an academic fact aloud to the class with a missing word using an LCD projector, randomly selecting one student to provide a response, providing feedback, and then rereading the statement with no blank, allowing students to hear each correct answer twice for each review statement (Gardner et al., 1994).

Beginning on day two of baseline, teachers assessed the students' learning with a next-day quiz. Teachers set a timer allowing students a maximum of 10 minutes (Shirvani, 2009) to complete the 10 fill-in-the-blank statements using the 15-term word bank. Students arriving late to class after the 10-minutes did not take the quiz; however, students arriving during the 10-minute time limit were permitted to complete as much of the quiz as time permitted. A 40-item probe was completed by each class the last day of baseline.

Alternating treatments: HR and RC. Prior to the alternating treatment phase, Robert and Lillian attended a training session for implementing RC. Teachers introduced the RC to their respective classes on the same day the students took the 40-item probe. During this phase, the HR condition continued as described in baseline, randomly alternating with the RC condition. Conditions were randomly assigned with the teachers opening an envelope prior to each review session. Before day one of implementation, a two-week randomized schedule was created to reduce situations of bias that may occur during quiz preparation and to ensure an equal number of daily reviews would occur for each condition (Cooper, Heron, & Heward, 2007; Kazdin, 2011). Therefore, each condition occurred five times (50%) over every two-week period.

The alternating treatment phase remained in place for Class A for 10 class sessions when the RC condition demonstrated a higher degree of effectiveness based on individual next-day-quiz scores demonstrated by mean scores of 10% or higher on quizzes following RC reviews compared to quizzes following HR reviews (Marmolejo et al., 2004) for three of the four target students. Class B remained in the alternating treatment phase for an additional 10 class sessions because based on percentage correct on next-day quizzes, one treatment did not emerge as more effective than the other. At the end of the second phase the school year ended.

Social Validity

To measure participant satisfaction, students and teachers completed the *Treatment Acceptability Rating Form—Revised* (TARF-R; Reimers & Wacker, 1988) at the conclusion of the study. On the last day of data collection, the researcher administered the student TARF-R to the class. The student TARF-R took approximately 10 minutes to complete and students were asked to provide details of how participation in this study affected their daily work habits and overall achievement. Using a 7-point Likert scale, students rated (1) how effective they perceive using RC compared to HR was on class participation and learning; (2) how effective they perceive using RC

compared to HR was on quizzes and biweekly tests' and (3) if they enjoyed using RC and would they want to use RC in other classes.

Teachers also were asked to complete the TARF-R on the last day of intervention. Both teachers completed it while the researcher administered the student TARF-R. The teacher TARF-R (available on request) consisted of three categories assessing treatment acceptability, perceived effectiveness, and perceived disadvantages using a 7-point Likert scale. Teachers were asked to provide details of how participation in this study affected their daily class schedule and overall routine and how using response cards could be made more efficient.

Treatment Fidelity

An observation checklist was used to assess fidelity of intervention implementation during the first 10 minutes and the final 10 minutes of each class session by the researcher. Fidelity of implementation was recorded as event recording and reported as percentage of fidelity of implementation by dividing the total number of components completed by 70, then multiplying by 100%. Prior to baseline, two graduate research assistants (GRA) were trained on all data collection instruments. During inter-observer agreement (IOA) observations of fidelity, the observers independently and simultaneously observed the first 10 minutes and the final 10-minutes of each class session throughout the study using the observation checklist. IOA was determined using point-by-point agreement, calculated by dividing the total agreements by the agreements plus disagreements and multiplying by 100%.

Fidelity of implementation was assessed in Class A for 63.6% of sessions across all phases resulting in a $M = 98\%$ (range, 91% to 100%). Fidelity of implementation was assessed in Class B for 46% of sessions across all phases resulting in a $M = 92\%$ (range, 66% to 99%). For Class A, IOA of fidelity of implementation was measured for 35.7% of sessions across phases with agreement at a $M = 99\%$ (range, 99% to 100%). For Class B, IOA of fidelity of implementation was measured for 57% of sessions across phases with agreement at 100%.

Inter-observer Agreement

IOA of the dependent variables, attempted responses and biweekly probes, were completed during sessions across all phases. IOA for all dependent variables were determined using point-by-point agreement, calculated by dividing the total agreements by the agreements plus disagreements and multiplying by 100%. In Class A, IOA were collected for 33.3% of dependent variables resulting in overall IOA for attempted responses a $M = 97.8\%$ (range, 93.3% to 100%) and biweekly probes a $M = 100\%$. In Class B, IOA were collected 33.3% of sessions for attempted responses and 66.7% of biweekly probes resulting in IOA for attempted responses a $M = 97.8\%$ (range, 93.3% to 100%) and biweekly probes a $M = 99.5\%$ (range, 98.6% to 100%).

RESULTS

Student Engagement

Student engagement was measured by attempted responses to answer the first question regarding the effect RC would have on student engagement for students without disabilities and students with disabilities who exhibit challenging behaviors in high school academic classes. The implementation of RC resulted in improved student participation as demonstrated by an increase in the percentage of questions students attempted to answer during daily reviews.

Attempted responses for target students are presented in Table 1. All of the target students with disabilities and challenging behavior and students without disabilities increased attempted responses during RC condition. In Class A, Wayne, the student with EBD and a BIP attempted responses a $M = 5.4\%$ (range, 0% to 13%) during baseline/HR. During alternating treatments, Wayne demonstrated an increase in attempted responses from a $M = 5.1\%$ (range, 0% to 13.3%) during HR condition to a $M = 46.4\%$ (range, 7% to 71.4%) during RC condition. Jaime, the student with LD and a BIP in the same class, did not attempt to respond during baseline/HR (0%). During alternating treatments, Jaime demonstrated an increase in attempted responses from a $M = 3.5\%$ (range, 0% to 7%) during HR condition to a $M = 43.8\%$ (range, 33.3% to 53.3%) during RC condition. Kathy, one target student without disabilities, attempted responses a $M = 3.5\%$ during baseline/HR condition. During alternating treatments, Kathy demonstrated an increase in attempted responses from a $M = 2.6\%$ (range, 0% to 13.3%) during HR condition to a $M = 40.8\%$ (range, 0% to 87%) during RC condition. And Drew, the other target student without disabilities, attempted responses a $M = 18.7\%$ (range, 0% to 26.7%) during baseline/HR condition. During alternating treatments, Drew demonstrated an increase in attempted responses from a $M = 24.1\%$ (range, 0% to 86.7%) during HR condition to a $M = 67.1\%$ (range, 50% to 93.3%) during RC condition. In Class A, the overall increase for attempted responses during the alternating treatment phase for all students with and without disabilities was just over a $M = 40\%$.

In Class B, Eric, the student with ASD and a BIP attempted responses a $M = 17.5\%$ (range, 0% to 43.3%) during baseline/HR condition. During alternating treatments, Eric demonstrated an increase in attempted responses from a $M = 16.9\%$ (range, 13% to 33.3%) during HR condition to a $M = 63.9\%$ (range, 33.3% to 100%) during RC condition for an overall increase of a $M = 47\%$; while Kyle, the student without a disability, attempted responses a $M = 2.2\%$ (range, 0% to 13.3%) during baseline/HR condition. During alternating treatments, Kyle demonstrated an increase in attempted responses from a $M = 1.5\%$ (range, 0% to 13.3%) during HR condition to a $M = 55\%$ (range, 40% to 88.9%) during RC condition for an overall increase of a $M = 53.5\%$. In Class B, the overall increase for attempted responses during the alternating treatment phase for all students with and without disabilities was just over a $M = 50.3\%$.

Table 1. Percent of Attempted Responses Across Experimental Phases

Class A	Mean Percentage Attempted Responses (range)		Mean Percentage Attempted Responses (range)
Wayne (E/BD)		Kathy (Gen Ed)	
Baseline	5.4% (0-13.3)	Baseline	3.5% (0-7)
Hand Raise	5.1% (0-13.3)	Hand Raise	2.6% (0-13.3)
Response Cards	46.4% (7-71.4)	Response Cards	40.8% (0-87)
Jaime (LD)		Drew (Gen Ed)	
Baseline	0%	Baseline	18.7% (0-26.7)
Hand Raise	3.5% (0-7)	Hand Raise	24.1% (0-86.7)
Response Cards	43.8% (33.3-53)	Response Cards	67.1% (50-93.3)
Class B	Mean Percentage Attempted Responses(range)		Mean Percentage Attempted Responses(range)
Eric (E/BD)		Kyle (Gen Ed)	
Baseline	17.5% (0-43)	Baseline	2.2% (0-13)
Hand Raise	16.9% (13-33)	Hand Raise	1.5% (0-13)
Response Cards	63.9% (33-100)	Response Cards	55.0% (40-89)

Academic Achievement

Academic achievement was measured by accuracy of responses on biweekly probes (see Tables 2 and 3). The biweekly probes provide information on the ability of students with and without disabilities to retain content learned over an extended time. On the alternating conditions probe, half the items were from each condition (i.e., HR and RC) with 40% of the items copied from the daily quizzes, 40% of the items similar to the quizzes, and 20% exact items from the reviews, not previously quizzed. On the baseline/HR probe, Wayne (EBD) answered 13% of both exact and similar statements previously quizzed correctly and 11% of previously reviewed but never quizzed statements correctly. On the alternating treatments probe Wayne answered 50% of the RC items correctly and 40% of the HR items correctly. On the baseline/HR probe, Jaime (LD) answered 31% of the exact items previously quizzed correctly, 19% of the similar statements previously quizzed correctly, and 11% of the reviewed but never quizzed statements correctly. On the alternating treatments probe Jaime answered 35% of the RC items correctly and 10% of the HR items correctly. Kathy (Gen) answered 50% of the exact statements previously quizzed correctly, 66.7% of the similar statements previously quizzed correct, and 88.9% of the reviewed but never quizzed statements correctly. On the alternating treatments probe Kathy answered 70% of the RC items correctly and 40% of the HR items correctly. Drew answered 68.8% of the exact statements previously quizzed correct, 64.7% of the similar statements previously quizzed correct, and 100% of the reviewed but never quizzed statements correctly. On the alternating treatments probe Drew answered 805% of the RC items correctly and 65% of the HR items correctly.

Table 2. Bi-weekly Probe Scores for Class Mean and Target Students: Class A

BaselineProbe (# of Q) ¹	Class			Wayne (ED)			Jaime (LD)			Kathy (Gen)			Drew (Gen)			
	HR Quiz (16 Q)	HR Similar (16 Q)	HR Review (8 Q)	Percentage Correct (40 Q)	HR Quiz (8 Q)	HR Similar (8 Q)	HR Review (4 Q)	Percentage RC Correct (20 Q)	HR Quiz (8 Q)	HR Similar (8 Q)	HR Review (4 Q)	Percentage RC Correct (20 Q)	HR Quiz (8 Q)	HR Similar (8 Q)	HR Review (4 Q)	Percentage HR Correct (20 Q)
Class	54.2%	51.7%	69.8%	53.9%												
Wayne (ED)	13%	13%	11%	13%												
Jaime (LD)	31%	19%	11%	23%												
Kathy (Gen)	50%	67%	89%	64%												
Drew (Gen)	69%	637%	100%	73%												
Alternating Treatment Probe																
Class	47%	45%	42%	46%	36%	45%	24%	46%	36%	45%	24%	46%	36%	45%	24%	37%
Wayne (ED)	50%	63%	25%	50%	25%	50%	50%	50%	25%	50%	50%	50%	25%	50%	50%	40%
Jaime (LD)	38%	25%	50%	35%	0%	25%	0%	35%	0%	25%	0%	35%	0%	25%	0%	10%
Kathy (Gen)	88%	50%	75%	70%	50%	50%	75%	70%	50%	50%	75%	70%	50%	50%	75%	40%
Drew (Gen)	63%	88%	100%	80%	63%	88%	100%	80%	63%	88%	100%	80%	63%	88%	100%	65%

Q = total number of each type of question per section. Shaded areas highlight comparison of the two strategies and represent the grade a student might earn on a subject test using each strategy during content instruction. Both class average and averages of target students show more RC items were remembered over time than HR items.

Table 3. Bi-weekly Probe Scores for Class Mean and Target Students: Class B

Baseline Probe (# of Q)I	HR			RC			HR			
	HR Quiz (16 Q)	HR Similar (16 Q)	HR Review (8 Q)	RC Quiz (8 Q)	RC Similar (8 Q)	RC Review (4 Q)	HR Quiz (8 Q)	HR Similar (8 Q)	HR Review (4 Q)	
Class Mean	71.2%	75%	65%							
Eric (ASD)	73.3%	60%	50%							
Kyle (Gen)	86.7%	73.3%	70%							
Alternating Treatments Probe 1										
Class Mean	90%	82.5%	66.7%	82.3%			75%	65%	76.7%	71.3%
Eric (ASD)	75%	63%	25%	60%			50%	25%	75%	45%
Kyle (Gen)	75%	75%	50%	70%			50%	75%	50%	60%
Alternating Treatments Probe 2										
Class Mean	83.3%	70%	61%	73.9%			63.9%	78.5%	70.8%	71%
Eric (ASD)	75%	50%	50%	60%			38%	50%	50%	45%
Kyle (Gen)	100%	75%	100%	90%			88%	88%	75%	85%

Q = total number of each type of question per section. Shaded areas highlight comparison of the two strategies and represent the grade a student might earn on a subject test using each strategy during content instruction. Both class average and averages of target students show more RC items were remembered over time than HR items.

In Class B, Eric (ASD) answered 73% of the exact statements previously quizzed correctly, 60% of the similar statements previously quizzed correctly, and 50% of the reviewed but never quizzed statements correctly. On the first alternating treatments probe Eric answered 60% of the RC items correctly and 45% of the HR items correctly. On the second alternating treatments probe Eric answered 60% of the RC items correctly and 51% of the HR items correctly. Kyle (Gen) answered 86.7% of the exact statements previously quizzed correct, 73.3% of the similar statements previously quizzed correctly, and 70% of the reviewed but never quizzed statements correctly. On the first alternating treatments probe Kyle answered 71% of the RC items correctly and 60% of the HR items correctly. On the second alternating treatments probe Kyle answered 90% of the RC items correctly and 85% of the HR items correctly.

Overall, the target students in Class A scored a $M = 58.8\%$ of RC items correctly compared to a $M = 48.5\%$ of HR items correctly, remembering 10.3% more RC items over time. Overall, the target students in Class B scored a $M = 70.3\%$ RC items correctly compared to a $M = 63.5\%$ of HR items correctly, remembering 7.2 % more RC items over time.

Social Validity

Social validation was measured by normative comparisons (Kennedy, 2005) and subjective evaluations (Alberto & Troutman, 2009; Kazdin, 2011). Each area was assessed differently, yet each is an equally important social variable, which is an important part of behavioral research in applied settings (Alberto & Troutman, 2009; Kazdin, 2011). Normative comparisons were assessed throughout each phase using behavioral and academic data from students with disabilities who have a BIP and their peers. Interesting, yet not part of the current study, each teacher mentioned several times during the course of this study they were using RC in other courses they were currently teaching. Each also expressed disappointment during the alternating treatment phase on the days the HR was selected.

The subjective evaluation was accomplished using the TARF-R (Reimers & Wacker, 1988) and was completed by both teacher participants and their classes, including the target students. This measure was used to determine what, if any benefits may come from using RC as a class wide teaching strategy (see table 4).

Both teachers rated RC as a very acceptable teaching strategy for high school students and a very valuable instructional tool to be used during instruction as well as reviews. Both teachers credited RC for increasing participation for students with and without disabilities and reported they would continue to use RC in future classes. A secondary benefit of using RC reviews came to light when Robert reported preparing questions to use with RC helped him organize and focus instruction. He also noted using RC helped him see immediately what material needed re-teaching. Lillian reported the increased review time with RC provided more material overlap allowing increased reinforcement. Both teachers noted RC increased biweekly probe scores for some students. Neither teacher reported any negative outcomes from using RC.

The students in Class A responded favorably to using RC. Sixty-eight percent of the 19 students completing the survey reported RC increased their time on-task, 89.4% reported their grades went up, and 50% reported RC helped them learn. All

19 students reported that daily reviews at the end of class were helpful in learning; and 88% reported daily quizzes were helpful for learning. Although only 35% of the students rated RC as a strategy they liked to use, 41% reported RC might be helpful in other classes. Thirteen of the 19 students wrote comments in favor of RC, daily reviews, and daily quizzes. And 5 of the 13 reported RC helped them be more active, participate more, or pay attention more than ever before; and 6 of the 13 wrote they learned more (or learned a lot). Nine comments were written listing negative aspects of the study. Four stated 'it' was boring and took forever, two suggested not doing 'it' everyday, and two complained 'it' was difficult because some students would not pay attention or 'shut-up' therefore causing disruption.

Of the students in Class B, 72% of the 17 students who completed the survey reported RC increased their time on-task, 76% reported their grades went up, and 99% reported RC helped them learn. Additionally, 94.4% of the students reported daily reviews at the end of class were helpful in learning; and 88.9% reported daily quizzes were helpful for learning. In regard to whether the students liked using RC to learn, 66.7% reported they liked using RC, and 76.5% reported RC might be helpful in other classes. Of the 17 students completing the survey, 13 wrote favorable comments reporting they had fun, learned easier, learned more, earned higher grades, paid more attention in class, and remembered more for tests.

Table 4. Student and Teacher Perceptions of Using Response Card

High School Students Perception of Using Response Cards							
	RC increased time on-task	RC increased grades	RC helped them learn	Daily Reviews increased learning	Daily Quizzes Increased learning	Enjoyed using RC	RC may help in other classes
Class A	68%	89.4%	50%	100%	88%	35%	41%
Class B	72%	76%	99%	94.4%	88.9%	66.7%	75%
High School Teachers Perception of the Use of Response Cards							
<ul style="list-style-type: none"> • RC are a valuable teaching strategy for high school content classes • RC increased learning for students with and without disabilities • RC are an affective teaching tool • Beneficial to use RC during instruction as well as reviews • Preparing for the use of RC helped organize daily lessons • Reviewing daily with RC provides overlap & repetition of material • Some students experienced an increase in grades 							

DISCUSSION

RC are supported in the literature as an effective teaching strategy to increase time engaging with the learning by increasing attempted responses (Adamson & Lewis, 2017; Christle & Schuster, 2003; Gardner et al., 1994), time on-task (George, 2010), and academic achievement (Cavanaugh et al., 1996; Kellum et al., 2001). Previous studies have found improved participation resulted in improved daily quiz

scores (Marmolejo et al., 2004), improved biweekly tests (Gardner et al., 1994), and improved chapter test grades (George, 2010). Results from the data collected in this study indicate RC implementation as a teaching strategy for high school students with disabilities with challenging behaviors and students without disabilities is effective for increasing student engagement and achievement in academic classes required for state assessments and graduation.

During this study, RC increased student engagement by increasing the percentage of attempted responses for all six target students. When using RC, attempted responses increased during daily reviews from 37% to 53%, with half the students attempting to respond about 45% more often when using RC than when using HR. The increase in student engagement when RC were used may have led to the increase in academic achievement.

The biweekly probes showed all six target students had increased long-term retention of material reviewed using RC compared to material reviewed using the more traditional approach of HR. And when examining the validity of using RC at the high school level in core content areas, the results of the student surveys indicate that students with and without disabilities enjoyed using RC. These students, ranging from ninth through twelfth grades, reported RC helped them learn more by keeping them on-task, paying more attention to the lesson, allowing them to learn more, and improving their grades. Many students reported they enjoyed using RC as a learning strategy and think RC would be helpful in other courses. Both teachers reported RC could be a valuable teaching strategy in general education classes for students with and without disabilities to increase engagement, to review material, and to assess student knowledge.

A benefit of this study was the teachers, rather than the researcher, implemented RC with ease and consistency. Thus, indicating RC may be efficiently implemented with fidelity by high school classroom teachers.

LIMITATIONS AND FUTURE DIRECTIONS

There are several limitations of this study which may hinder the generalization of the findings. First, the number of participants in the study was small with three students with disabilities and three typical peers, and all participants with disabilities were male. Also, of the three students with disabilities in the study, each had a different disability (LD, EBD, and ASD) which further limits generalization. Furthermore, each student with a disability had varying histories and topographies of challenging and disruptive classroom behaviors. Replication of this study with more high school participants with and without disabilities is warranted to provide more generalizable evidence on whether RC are more effective than HR during academic general education inclusion classes.

Second, classroom management and instructional strategies differed between the teacher participants which may have influenced the data. In Class A during instruction, the students were required to be seated, quiet, and non-disruptive. However, students were allowed to read, sleep, eat, put on make-up, do other assignments, use computers, and come and go from class. In Class B, the students were required to be on time, to begin work immediately, to have only work-related items on their desks, and to participate during instruction. These classroom

management differences may account for some of the differences in target students' class participation.

In addition, although treatment fidelity was consistent in both classes instruction differed. No measurement was used to determine the effectiveness of instruction. It is plausible that results were influenced by how effectively the teachers presented the material. A third consideration related to classroom management and effective instruction includes consideration of the novelty of RC and the possible effect using RC daily may have had on data. Several students reported using RC was helpful but using them every day was too intensive. Future researchers may want to (1) better control or match classroom management strategies to assist in generalization of the effectiveness of RC, (2) use RC less often to examine if results differ based on frequency of RC use; and (3) include a measure for effectiveness of classroom instruction.

Third, various temporal issues may have influenced student outcomes. For example, instructional time was limited by incorporating daily reviews during the 50-minute class sessions restricted the amount of new information taught each session. In addition, teachers were required to spend time on previously learned material to prepare students for the end-of-year state testing mandatory for graduation. Students took the state test before the conclusion of the study, resulting in an attitude from some students of 'we are finished learning' for the year. Finally, the conclusion of the school year prevented maintenance observation sessions to investigate the effect of RC over time. Future researchers may investigate (a) using RC during the lesson rather than as an end-of-class review, (b) implementing RC earlier in the school year when students are learning more new material, and (c) extending the length of the study to determine if on-going RC would continue to increase student participation and retention of material learned over time.

IMPLICATIONS FOR CLASSROOM PRACTICE

The need for efficient and effective instructional strategies to increase student achievement is reported by general and special education teachers (Idol, 2006; Mastropieri & Scruggs, 2001). The findings from this study indicate (a) RC are easily and efficiently executed in large groups, (b) RC offer a hands-on strategy compatible with direct instruction allowing the teachers to continue using lecture for instruction, while also assessing student understanding, (c) preparing reviews and daily quizzes guide teachers to remain focused on the day's learning objectives, and (d) encouraged teachers to maintain a brisk pace to cover the planned instruction.

During this study, the increased levels of student responding and increased achievement by individual target students indicates using RC in high school classes could raise individual grade point averages by one letter grade (i.e., 10%) and may increase student test scores by increasing the amount of material retained over time. As previously reported (Gardner et al., 1994; George, 2010), students preferred RC over HR. In this study, 76% of the students reported using RC increased their learning. The students in this study reported that RC increased their attention to the lesson and allowed them to be more involved. One student reported appreciation that the whole class was able to be involved. The increased student participation and achievement using RC in Math Models and Integrated Physics and Chemistry indicates using RC

may be useful in other high school classes required for graduation. Although future research is warranted to minimize the limitations of the current study, the findings of this study support previous research in using RC as an evidence-based teaching strategy for all students.

In conclusion, results of this study support the use of RC to increase student participation and student achievement in academic high school classes. Furthermore, the results indicate using RC as an intervention for students with disabilities may also benefit students without disabilities in general education classrooms at the high school level.

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