6-26-2019

The effects of using mini whiteboards on the academic performance and engagement of students in a tenth grade resource English/Language Arts classroom

Elizabeth Catherine Gimbutas
Rowan University

THE EFFECTS OF USING MINI WHITEBOARDS ON THE ACADEMIC PERFORMANCE AND ENGAGEMENT OF STUDENTS IN A TENTH GRADE RESOURCE ENGLISH/LANGUAGE ARTS CLASSROOM

by

Elizabeth Catherine Gimbutas

A Thesis

Submitted to the
Department of Interdisciplinary and Inclusive Education
College of Education
In partial fulfillment of the requirement
For the degree of
Master of Arts in Special Education
at
Rowan University May 10, 2019

Thesis Chair: Amy Accardo, Ed. D.

Dedication

I would like to dedicate this thesis to my husband, Justin. I could not have completed my research and persevered in this endeavor with out your constant support. Thank you for believing in me and helping me believe in myself when I experienced doubt. You have been a continuous reminder of why I strive to make myself a better person each day. I hope to make you proud and to continue to better myself for our family.

Acknowledgements

I would like to express my appreciation to Professor Amy Accardo for her guidance and assistance throughout this research. The experience and skills I have gained through this process will help me be a more effective educator and advocate for my students. I look forward to my continued growth and development as I take on future challenges and educational roles.

Abstract

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The purpose of this study was to: (a) examine the effectiveness of mini whiteboards in increasing engagement, (b) examine the effectiveness of mini whiteboards in increasing academic achievement, and (c) determine if students in a tenth grade English/Language Arts resource center classroom are satisfied with the use of mini whiteboards. The research was conducted using an ABAB single-subject design methodology. Student achievement was evaluated through weekly assessments, while daily engagement was evaluated using interval recording in 5-minute increments. Results suggest that the use of mini whiteboards may help increase the engagement and academic achievement of students in a tenth grade ELA resource center classroom. Mini whiteboards were found to increase the weekly mean engagement score for 7 out of 10 students, and the weekly academic achievement score for 8 out of 10 students. Results also show that most students felt comfortable using the mini whiteboards and some felt that it helped them academically. Implications for educating students in a resource center setting include the recommendation to utilize active responding techniques such as mini whiteboards in the classroom.

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Chapter 1

Introduction

Over the course of the development of formal education, teaching strategies have been continually modified to best meet the needs of students. This often results in new philosophies developed through teacher education every so many years (Glass, 2000). In terms of educational strategies, those that elicit high response rates from students have been shown to be beneficial (Randolph, 2007). Response cards (RC) are one method of student response system (SRS) that are low-technology but allow for increased active responding at an accelerated pace over single-student response (SSR) (Randolph, 2007). Glass (2000), suggests that positive teaching strategies are most frequently seen with more experienced teachers, however, than with those most recently educated. The present study will investigate the use of RC by a recently educated teacher as a means to improve the outcomes of students with ADHD and attention issues.

RC may be pre-printed cards or boards that students can write on (Randolph, 2007). Students are given a question or prompt, hold up the card in response, and receive immediate feedback from the teacher, also giving the teacher a quick and clear image of student understanding, which can help inform instruction (Randolph, 2007). In contrast to SSR, the use of RC allows for multiple students to respond and receive feedback for each question or prompt, drastically increasing opportunities for active responding (Randolph, 2007). The present study will utilize mini whiteboards as an active response method.

Statement of Problem

Students diagnosed with ADHD as well as those with other diagnoses in special education often display attention issues that negatively impact their education (Wood & Beattie, 2015). The researchers report several negative impacts of attention issues including an ease of distraction leading to missed information, low self-esteem resulting from past poor grades or tasks that seem too large which can cause the student to shut down, difficulty adjusting between ideas and tasks, difficulty focusing on the written word, and difficulty responding to questions and prompts immediately which can make students feel rushed and stressed (Wood & Beattie, 2015). Lack of focus and disruptive behaviors are significant obstacles for an effective learning environment; however, teachers can often decrease the frequency of disruptive behaviors by up to 90% by using active responding techniques that increase student response rates and on-task behavior and decrease disruptions (Lambert et al., 2006). Class time spent on managing disruptive behaviors only succeeds in decreasing the amount of instruction occurring, which increases the rate at which students are falling behind (Lambert et al., 2006). Increased participation has been found to be a key strategy to accelerate student learning (Stowell & Nelson, 2007). It has also been shown that "practice, feedback, and active involvement constitute three important elements of classroom learning processes" (Trees & Jackson, 2007, p.22). Students who are unfocused or passive learners can be better engaged through more active SRS (Preszler, Dawe, Shuster, & Shuster, 2006).

Lambert, Cartledge, Heward, and Ya-yu (2006) suggest the need for evidence-based practices to combat the negative impact that student attention issues have on

academic achievement. The negative impacts of attention issues previously described lead to students feeling frustrated, stressed, and ill-equipped for the tasks being set before them, which contributes to a lower rate of academic achievement (Wood & Beattie, 2015). Hamilton and Astramovich (2016) lament that much research that has been done on ADHD fails to inform instructional strategies that can be used by teachers and that most teachers do not understand the features of ADHD and lack behavior strategies to best aid the learning of this population. The researchers state that support is needed for students with ADHD to be successful in the academic environment (Hamilton & Astramovich, 2016). Active responding techniques aim to decrease the amount of time elapsed between each component of a lesson to best engage students and to provide as many opportunities for learning as possible (Randolph, 2007). Active reviewing has been shown to have a positive impact on assessment scores over passive reviewing (Cavanaugh et al., 1996).

Significance of Study

Research has found that the use of SRS may significantly increase student engagement and academic achievement (Preszler, Dawe, Shuster, & Shuster, 2006; Penuel et al., 2007; Stowell & Nelson, 2007; Kay & LeSage, 2009; Fallon & Forrest, 2011; Heaslip et al., 2013; Tlhoaele et al., 2014; Musti-Rao et al., 2008; Lambert et al., 2006; Christle & Schuster, 2003; Gardner et al., 1994; Maheady et al., 2002; Randolph, 2007; Cavanaugh et al., 1996). Some research focuses on the specific SRS of mini whiteboards in various settings and subject areas (Musti-Rao et al., 2008; Lambert et al., 2006; Christle & Schuster, 2003; Gardner et al., 1994; Maheady et al., 2002; Randolph,

2007; Cavanaugh et al., 1996). However, there is little research about mini whiteboard use at the high school level or in the English language arts classroom. In addition, few studies have examined the impact of mini whiteboard use on students with ADHD and other attention issues.

This study will add to the literature by investigating the effects of using the SRS of mini whiteboards as formative assessment (FA) to increase the engagement and academic performance of students in a tenth grade resource room English language arts class. The present study aims to use mini whiteboards to increase student academic performance and engagement in the area of English language arts. Results of this study may provide implications for teaching students with attention issues using active responding techniques.

Purpose of Study

The purpose of this study is to: (a) examine the effectiveness of mini whiteboards in increasing the engagement of students in a tenth grade resource room English class, (b) examine the effectiveness of mini whiteboards in increasing the academic achievement of students in a tenth grade resource room English class, and (c) determine if students in a tenth grade resource room English class are satisfied with the use of mini whiteboards.

Research Questions

1. Will the use of mini whiteboards improve student attention and focus of high school students with learning disabilities?

2. Will the use of mini whiteboards improve academic achievement of high school students with learning disabilities?
3. Will students be satisfied with the use of mini whiteboards for assisted instruction in a high school English classroom?

Key Terms

For the purpose of this study:

At-risk students will refer to students in danger of failing academically in the area of Reading/language arts.

Formative assessment (FA) will be defined as a type of assessment that checks for student learning at different points throughout the learning process to inform next steps in teacher instruction.

Student response systems (SRS) will be defined as a strategy that allows students to immediately respond to teacher created questions, as well as teachers to provide instant feedback to their students.

Single student response (SSR) will refer to the traditional response method of a teacher calling on individual students who raise their hands in response to questions.

Response cards (RC) will be defined as cards, signs, or dry erase boards that contain a response option or allow students to write a response that is shared as a whole class.

Mini Whiteboards will refer to a SRS that allows students to demonstrate their learning of given concepts by writing or drawing on a small dry erase board and holding it up to display their answers.

Chapter 2

Review of the Literature

Attention and focus issues are a major obstacle for students in the classroom setting (Wood & Beattie, 2015). Danielson et al. (2018) found that in 2016, 9.4% of children aged 2 to 17 received a diagnosis of ADHD. Wood and Beattie (2015) express concern that not only are a significant number of students affected by ADHD, but that the expertise of those who work with ADHD-diagnosed students on a daily basis and their repertoire of effective strategies for working with this population is often insufficient. It is necessary to implement evidence-based practices for increasing student attention and focus to avoid the negative impact time spent on classroom management can have on the academic performance and progression of students (Lambert, Cartledge, Heward, & Ya-yu, 2006). The concept of active responding is made of three components, "an instructional antecedent, a student response, and teacher feedback" (Randolph, 2007, p.113). The aim of active responding is to decrease the amount of time lapsed between each of these components to best engage students and to provide as many opportunities for learning as possible (Randolph, 2007). This literature review will discuss the need to increase the focus and academic achievement of students in the resource center setting for English/language arts instruction, the opportunity for technology-based and low-tech methods to be used as a FA and SRS, their potential benefits on increased student focus and academic performance, and the potential benefit of the specific SRS of mini whiteboards.

Student Response Systems

SRS can be found in a variety of settings from primary schools to secondary schools, and even in college and university classrooms (Fies & Marshall, 2006). SRS are methods that allow students in a classroom to quickly submit a response to a question posed by the teacher and for their responses to be displayed and quickly assessed. These range from low-technology, which Lambert et al. (2006) define as signs or cards to be held up by students to show their responses to questions or prompts provided by the instructor, to high-technology systems, defined by Stowell and Nelson (2007) as "clickers," which allow students to use handheld devices that send their responses to the instructor's computer. With these devices, responses to questions and results can be displayed and graphed, allowing for quick and easy review.

While lack of focus and disruptive behaviors are major obstacles for an effective learning environment, teachers can often decrease the frequency of disruptive behaviors by up to 90% by employing instructional strategies that create high student response rates, increased on-task behavior, and decreased classroom disruptions (Lambert et al., 2006). Lambert et al. (2006) go on to describe one of the main benefits of SRS as "total class involvement," where all students are responding to questions and prompts quickly and eagerly. This can encourage even the most reluctant students to participate with the rest of the class without fear of embarrassment. Students who display significant attention and behavior issues are often academically behind their classmates (Lambert et al., 2006). Class time spent on managing these disruptive behaviors only succeeds in decreasing the amount of instruction occurring in class, which increases the rate at which theses students

are falling behind. The use of SRS, on the other hand, has been shown to increase positive behaviors and participation in the classroom and minimize disruptive behavior (Lambert et al., 2006).

Increasingly, teachers of primary and secondary education are using technology-based response systems due to the potential benefits of increased participation, preparation for standardized tests, and more effective formative feedback to guide teacher instruction (Penuel, Boscardin, Masyn, & Crawford, 2007). The increased engagement of SRS can significantly decrease unfocused, passive behavior and increase rates of response (Preszler et al., 2006). Stowell and Nelson (2007) suggest the need to examine not only how instructional strategies play a role in the acquisition of knowledge and skills but also how they relate to student emotions in regard to academics. They note the possibility of anonymous responses of clickers to be a benefit for students who are more introverted. These students may be less willing to raise their hands and speak publicly in class but can participate fully and comfortably through the use of clickers. Another benefit to using SRS may be the ease of displaying student responses with these electronic systems (Stowell & Nelson, 2007).

Technology-Based Student Response Systems and Participation

Due to the increasing popularity of technology-based SRS, these and their impact on student attention/focus and academics will be discussed first. Technology-based SRS, previously referred to as clickers, have been found overall to increase student attention and focus in the classroom and may help decrease instances of disruptive and off-task behaviors. Preszler et al. (2006) studied the use of SRS in six biology courses at New

Mexico State University that utilized clickers in instruction through student surveys at the end of the semester to compile feedback on students' perceptions of the clickers. Their survey found that 81% of students felt that using clickers raised their interest in the course itself, and a majority of students claimed that clicker use had an improvement on their class attendance (Preszler et al., 2006). The researchers also report that viewing class wide responses from the clickers can spark discussions that lead to even more interactions between students and between students and instructors. This increased discussion allows for more cooperative learning. In addition, the ability to view immediate feedback from student responses allows students to collectively understand their class and their proficiency of the topics or skills being addressed. This increased self-awareness is beneficial for keeping students focused and on-task in order to improve their correct rates of response (Preszler et. al. 2006).

Penuel et. al. (2007) also considered the literature on SRS use at the level of higher education but aimed to understand its use and impact in primary and secondary education. They surveyed 548 K-12 teachers across subject areas about their frequency of use of SRS and their pedagogical beliefs. Their study concluded that similar to prior research conducted in the higher education setting, teachers using SRS in the K-12 setting perceive that it improves student engagement and experiences (Penuel et. al., 2007).

Fies and Marshall (2006) conducted a literature review and reported potential benefits of SRS to include increased student focus, greater student interest and enjoyment, and increased discussions and level of collaboration in higher education. In addition to increased interactions and engagement, the level of the class' understanding

becomes clearer to both students and instructors when they can view students' responses. This, in turn, improves student engagement by making them more aware of how they and their class are performing in relation to lesson goals Some limitation in this literature review were noted, as clear descriptions of ideal conditions and appropriate levels of rigor for SRS use had not been provided through the literature. It was supposed that the pedagogy of SRS use could be more indicative of improved student focus and participation than simply the presence of SRS alone (Fies & Marshall, 2006).

Stowell and Nelson (2007) also found increased participation to be a key strategy to accelerate student learning. Their study included 140 college students who were currently enrolled in foundational psychology courses. They asked these students to attend mock lessons on psychology and exposed them to traditional lectures followed by either a review using the standard single student response (SSR) format, a review using paper response cards (RCs), or a review using clickers to respond to questions. They found the most obvious advantage of clickers to be increased rates of participation and honestly of student responses and feedback. Students in the SSR and RC groups were both perceived to be influenced by peers when responding. Though students showed some hesitation in the RC group, they and students in the clicker group reached nearly 100% participation in contract to only 76% on the SSR group (Stowell & Nelson, 2007).

Trees and Jackson (2007) compiled survey responses of more than 1500 students enrolled in undergraduate courses. The researches stated that "practice, feedback, and active involvement constitute three important elements of classroom learning processes" (Trees & Jackson, 2007, p.22) and sought to determine if clickers increased opportunities

for these elements in lecture classes. Trees and Jackson (2007) found that students who viewed feedback as imperative preferred the increased involvement and immediate feedback of clicker use. They also found that clicker use itself did not singlehandedly create more active classes but that students' perception of clickers as relating to the instructor's teaching style could increase active participation (Trees & Jackson, 2007). Trees and Jackson (2007) discovered that extrinsic motivation was provided in classes with clicker use because the participation was graded, thereby requiring students to attend class. They also found, however, that students who appreciated the motivation of clicker points also tended to have positive opinions of clicker use, which could suggest that rather than extrinsic, intrinsic motivation could be accessed by the desire to attend more interesting and engaging lessons (Trees & Jackson, 2007). Overall, the researchers found that positive impacts of clicker use were more dependent on student perceptions than on instructor's pedagogical styles or course design (Trees & Jackson, 2007).

Kay and LeSage (2009) agreed with the benefit of improved focus when they conducted a literature review of 67 peer-reviewed papers about the use of SRS, mostly in undergraduate classrooms and examined the context of the SRS use. They discovered that frequent positive interaction was more likely to occur in classrooms using SRS. Since many students who struggle to focus in class often play the role of passive observer, this potential benefit is significant. Increased interaction between peers and between students and instructor can dramatically improve student focus (Kay & LeSage, 2009).

Fallon and Forrest (2011) reinforce this benefit of SRS by describing clickers as having a game-like quality, which is likely to increase student participation and

experiences. In their study, undergraduate students enrolled in two sections of an introductory psychology course were observed with one section using RCs, and the other using clickers, though this assignment alternated so that both sections had experience using both. Observers recorded the participation levels of students as well as the length of discussion that occurred after each question. They discovered that students' anxiety of participating decreased with the use of both RCs and clickers but that clickers created a more significant decrease and that students much preferred the use of clickers for participation (Fallon & Forrest, 2011).

Even more recently, Heaslip, Donovan, and Cullen (2013) examined the impact of SRS on participation in large classes at the undergraduate level. In their study, Heaslip et al. (2013) performed a trial of SRS with students taking an Operations and Supply Chain Management course at an Irish University. They utilized a pre-test/mid-test/post-test design to identify improvements in levels of interactivity. The three tests consisted of a survey asking students about the ease of using the clickers and their impact on the student's level of interaction, while interviews intended to collect qualitative data at the end of the trial (Heaslip et al., 2013). The researchers found that interactivity levels increased over the course of the trial and that students attributed this to the clickers, which enabled them to receive immediate feedback. In addition, the ability of students to gauge their understanding of the material as compared to others in the class appeared to be a factor in the students' preference of clicker use (Heaslip et al., 2013).

Similarly, Tlhoaele, Hofman, Naidoo, and Winnips (2014) sought to tackle the universal issue of a lack of student engagement in lecture courses at the higher education

level. The researchers conducted a pre-test/post-test control group experiment with Engineering students in Gauteng, South Africa. The lecturer and teaching model were consistent across groups, but one group was exposed to clicker responding while the other group simply viewed lectures with PowerPoint presentations. Tests taken were the same in both groups (Tlhoaele et al., 2014). Tlhoaele et al. (2014) found that students were more actively involved in the discussions that resulted from the clicker responses, which allowed them to work collaboratively with their peers to problem solve. They believe that this allowed the students to recall new problem-solving skills for the tests. It was also discovered that immediate feedback from peers provided more positive impacts than delayed feedback from tests (Tlhoaele te al., 2014).

Fallon and Forrest (2011) noted another positive association of clickers being employed anonymously, preventing students from experiencing the fear of public humiliation. This is a strong support of SRS in settings with reluctant students. Stowell and Nelson (2007) previously noted the benefit of anonymous participation as allowing even the most introverted students a way to participate while avoiding negative emotions. In their study, the authors compared student responses in classroom situations of SSR, physical RCs, and electronic clickers. They determined that in the first two scenarios, students were influenced or inhibited by their peers. The clickers not only increased participation to almost 100% but also created an opportunity for shy or anxious students to submit responses without the stress of their classmates' feedback (Stowell & Nelson, 2007). In addition, Kay and LeSage (2009) cite anonymity as a motivation for student engagement, allowing students to participate without any negative emotions that may

occur from getting an answer wrong publicly. Heaslip te al. (2013) confirmed in their study that anonymity made students more compliant in participation and that this was a feature that students defined as very important.

Kay and LeSage (2009) noted other benefits to using electronic SRS in the classroom, reporting that attendance often increases for classes using SRS, especially those where SRS participation is part of the students' grade, where attendance increases reach 15%. Next, they comment on the notion that SRS provide improved attention by piquing students' interests, noting, however, that attention may decrease when instruction exceeds 20 minutes. To combat this, the authors suggest implementing SRS questions at around 20 minute intervals to allow students to shift their focus to responding and evaluating data before returning to the lecture style (Kay & LeSage, 2009).

Technology-Based Student Response Systems and Student Achievement

In addition to potential benefits for student attention and focus, studies also show potential benefits for academic achievement. Hunsu, Adesope, and Bayly (2016) performed a meta-analysis on studies that utilized specific research designs to determine the educational impact of clicker use. They reviewed 53 studies that met their criteria and coded 31 variables from the studies. Hunsu et al. (2016) found that the effect of using clickers, though small, had an important impact on student achievement. Positive effects were discovered in achievement and transfer of knowledge, though significant impacts were not found for retention. These positive effects were found on cognitive learning through the use of clickers compared to non-clicker lecture style classes. Small to medium impact was also noted for non-cognitive learning. Hunsu et al. (2016) also

concluded that significant effects were more likely with higher levels of the Bloom's Taxonomy scale than with lower level thinking. These positive effects appeared to be most significant with smaller class sizes (Hunsu et al., 2016). The researchers conceded that question-based pedagogies may have been the larger source of impact. They explained that the difference between clicker use and non-clicker use in question-driven lessons was minimal and that the difference between clicker use and classes which were not heavily question-based were more significant. Hunsu et al. (2016) suggest that instructors take care to develop effective questions for clicker use and to incorporate engaging and meaningful discussions around the questions, focusing on larger concepts rather than factual information.

Preszler et al. (2006) found similar results of high-technology SRS on student learning. Their study of clicker use in higher education suggested that student performance improved in regard to analytical concepts but not retention or memorization. To best utilize clickers in instruction, the researchers suggest frequent use of clickers across concepts with a constant focus on higher-order thinking rather than factual information (Preszler et al., 2006).

Similarly, Green (2016) found positive associations between clickers and student performance using a free teaching app called Socrative. In this study, the researcher enhanced 3 out of 4 of his own economics lecture classes by using Socrative to present review questions, attain student feedback, and provide exit ticket questions, while one control section was given the same questions verbally (Green, 2016). To review course material for quizzes in the experimental groups, the researcher presented quizzes via

Socrative and allowed students to work in groups to respond to them. In the control section, the quiz questions were reviewed verbally (Green, 2016). Additionally, the exit ticket feature required students in the experimental group to share what they learned, how well they comprehended the day's lesson, and to respond to a prompt on the board (Green, 2016). The researchers control group utilized lecture and class discussions with no clickers, while experimental group 1 consisted of lecture and discussion via Socrative. The other two experimental groups also used the lectures but instead of class discussions, Socrative was used to provide in-class simulation. Homework, as well as the pretest and posttest, were consistent across sections (Green, 2016). In this study, Green (2016) found an 8% increase in posttest scores of the experimental groups over that of the control group. This suggests a strong connection between the clicker use through Socrative and students' improved performance (Green, 2016). Though the data showed this positive link, the study did not indicate what aspect(s) of the clicker use contributed to this increased performance. The researcher noted that review sessions being infrequent likely indicated little connection to the improved scores and supposed that the exit tickets had a higher impact on performance (Green, 2016).

Brady, Seli, and Rosenthal (2013) sought to determine the impact of clickers and of low-technology paddles as a class response tool on metacognition. This study consisted of 198 undergraduate students in three sections of an educational psychology course. The same instructor taught each of the three sections, and the same course design was used (Brady et al., 2013). Since the summer course only had one section and had an accelerated pace, the class began using the RC paddles and later switched to clickers.

This experience was unique since this section of the course experienced both SRS methods (Brady et al., 2013). In the fall, two cohorts were examined with the experimental group using clickers and the comparison group using paddles. Otherwise, all aspects of the class including lecture style, question types, and weekly quizzes were the same (Brady et al., 2013). In all sections, SRS were used for questioning, formative assessment, opportunities for peer instruction, and polling. Also, in all sections, if significant variance was found in student responses, the instructor would facilitate peer-to-peer and whole-class discussion (Brady et al., 2013). The average of combined quizzes was used as the measure of student performance (Brady et al., 2013). The results of their study suggested that metacognition was better supported through the use of paddles over clickers. However, this finding was conflicting when the fall sections were compared to the summer section. In the summer section, clickers were linked to increased metacognition over the paddles (Brady et al., 2013). Perhaps more confusing, the fall clicker group outperformed the fall paddle group on quizzes. While paddles seemed to improve metacognition, clickers supported increased academic performance (Brady et al., 2013).

In contrast, Fallon and Forrest (2011) found in their study of two sections of a psychology course that clicker use did not create significant improvements in learning when compared to similar low-technology strategies. The researchers suggest that some students may experience benefits from the use of clickers, but that consistent improvement in learning outcomes was not indicated (Fallon & Forrest, 2011). Similarly, Lasry (2008) conducted a study of Canadian community college students who were

placed into two groups. Both groups were assessed prior to and after the study using the Force Concept Inventory. One group used flashcards in student-centered peer instruction, while the other group used clickers. The study suggested that the use of clickers had no substantial impact on the learning of concepts or performance on exams (Lasry, 2008).

Anthis (2011) conducted two studies to determine the relationship between clicker use and students' exam scores with surprising results. The first study included 73 students in two sections of an undergraduate level Child Development course. One section utilized clickers to respond to study questions and saw correct answers in the presentation after responses had been received. The other section did not use clickers but responded to questions by raising hands (Anthis, 2011). According to this study, clicker use was actually associated with lower exam scores, students in the non-clicker section having scored higher. The researcher supposed students in this second group may have had more time to record questions and answers for later studying or that critical thinking was more prominent in the class without clickers (Anthis, 2011). The second study sought to find if the results of study 1 were inaccurate due to differences between the two sections of the class. In this study, 52 students in two sections of an undergraduate Lifespan Development course participated (Anthis, 2011). Clicker use was not incorporated until the 6th week of the course. When using clickers, students viewed correct answers after the class had responded, while correct answers were also given after students responded in the hand raising procedure (Anthis, 2011). Prior to the second exam of the course, Section A responded to questions individually, while Section B used clickers to respond. For the third exam, this scenario was flipped. For the fourth exam, both sections used

clickers to practice responding to questions (Anthis, 2011). Unlike in study 1, this second study found no correlation between clicker use and exam scores. The researcher supposed the previous negative association may have been due to a specific artifact of the prior study. These results suggest that prior claims of positive clicker associations may have been rushed (Anthis, 2011).

Interestingly, Dallaire (2011) determined that many factors impacted the success of clicker use, most notably, students' perception of the clicker use in the class and clickers in general. This study consisted of 151 students in three psychology courses and one neuroscience course at the undergraduate level (Dallaire, 2011). First, a focus group was assembled including faculty and undergraduate students at the university. Via this focus group, a list of 7 items was created to document the various ways instructors utilized the clickers in their classes. Through the same focus group, a list of 6 common issues was compiled to document the issues that may occur with clicker use (Dallaire, 2011). The researcher then implemented a Likert-style survey to students about their perceptions of the effectiveness of clicker use in the seven most common uses: immediate feedback, understanding checks, enjoyment of lectures, opportunities for self-assessment, discussion stimulation, exam preparation, and concept application (Dallaire, 2011). At the conclusion of the courses, students were asked to submit their final grades for comparison. These were represented in a 12-point scale (Dallaire, 2011). This study suggests that student learning may be diminished if students perceive that instructors use the clickers either in too many different ways or do not use them frequently enough. Results also suggested that ideal clicker use might be four different methods (Dallaire,

2011). This study determined that the effectiveness of clickers relied heavily on methods of instructor use and the perceived value of clickers held by students (Dallaire, 2011). Specifically, the researcher found that when students identified their instructors as using clickers in multiple ways up to four different uses, their grades were higher, and they were more open to the possibilities of clicker use causing academic improvements (Dallaire, 2011).

Kulesza, Clawson, and Ridgway (2014) also found discrepancies between anticipated clicker benefits and the data and student perceptions. Their study comprised 40 students in a college level honors biology course. The instructor of the class utilized clickers to give quizzes during class as a means of formative assessment (Kulesza et al., 2014). These were completed on an individual basis and served as a review of the text and concepts from prior lectures. Not only did the clicker quizzes provide the instructor with feedback on students' attainment of the information, but they also provided students an opportunity to practice questions related to the content and provided correct answers immediately after responses were received (Kulesza et al., 2014). The researchers compiled response data for these questions. They also examined response data from 3 exams that students took in the course, including two midterms and a final (Kulesza et al., 2014). Next, they collected exam scores from a previous section of the same course and taught by the same instructor. This prior course included the same teaching strategies and textbook and involved a similar group of students (Kulesza et al., 2014). The researchers performed a comparison, focused only on the current course of students, between the student performance on exam questions that students had clicker practice with and

questions that they did not practice with the clickers. Student performance on exams was then compared between the current course and the previous section of the course (Kulesza et al., 2014). The results of this study indicated that students scored higher on exam questions when they had had practice on similar questions using the clickers. This suggests that clicker practice improved student learning and performance on the exams (Kulesza et al., 2014). In addition, students in the current clicker course performed better on the midterms than the students in the previous offering of the course (Kulesza et al., 2014). Conflicting with these findings, there was no difference between these students' scores on the final exam. The findings predicted that students in the clicker course would again outperform the prior section on the final, but this was not the case, even though the same amount of clicker practice had been afforded the clicker group for this exam (Kulesza et al., 2014). The researchers admit that their mixed findings may be due to the lack of intentional alignment between clicker and exam questions (Kulesza et al., 2014). These findings complicate the research suggesting that clicker use improves performance, but such research is still more prevalent.

Low-Technology Student Response Systems and Participation

While high-technology SRS have become a popular choice for educators across academic levels and subject areas, low-technology methods have also exhibited potential benefits for student attention and focus and student achievement. Nagro, Hooks, Fraser, and Cornelius (2016) performed a literary review on whole-class response strategies that improve student engagement. In their review, the researchers noted that whole-class instruction remains the most widely used design for instruction in inclusion classrooms.

Because of this dominance, the researchers identified the need to include strategies that maximize student participation and active engagement (Nagro et al., 2016). They also explain that the focus on responses by individual students leaves the class with very few opportunities to respond. This fuels the need for teaching strategies that promote high response rates and encourage all students to participate actively in responding, either verbally, with gestures, in writing, or electronically (Nagro et al., 2016). RCs were a focus of the study because students with learning disabilities often struggle with writing. The option to hold up cards with responses already on them accommodates this weakness and allows students to participate fully without the pressure of writing (Nagro et al., 2016). This method of responding also engages students who would not normally respond to questions and prompts with SSR. The researchers note that not only does this method increase student participation, which is likely to increase learning, but it also provides the teacher with important feedback which can inform future instruction (Nagro et al., 2016).

Clayton and Woodard (2007) studied the impact of RCs on participation at the college level. Their study consisted of two sections of a psychology course with the same instructor and comprised 120 students total (Clayton & Woodard, 2007). RCs used in this experiment were made of file folders with a cropped end and an intact end to respond to true/false questions. Review sessions would be conducted using true/false questions to facilitate these RCs (Clayton & Woodard, 2007). Student participation rates were assessed via videotaped recordings of classes which included review sessions. Participation was defined as SSR in the baseline and holding up the RC in the

experimental condition (Clayton & Woodard, 2007). The researchers used a reversal with added constant-series control design. The first section of the course was kept at baseline while the second section began with the baseline condition of SSR and switched to RCs then back to baseline in an ABA design (Clayton & Woodard, 2007). The results of this study indicated that RCs significantly increased students' participation. Students in the first section maintained a participation rate of 7.5-10% throughout the semester, while the second section began with 8.9% participation and improved to 93.3% during the RC condition, finally diminishing to 13.3% when the section returned to baseline design (Clayton & Woodard, 2007). The researchers attribute this change to an increased comfort level when responding with the rest of the class as opposed to being called on singularly (Clayton & Woodard, 2007).

Musti-Rao, Kroeger, and Schumacher-Dyke (2008) also examined the effect of RCs on participation at the college level. Their study involved a class of 19 undergraduate students in a special education course but focused on 5 target students: two low-responders, two high-responders, and one in the middle in terms of frequency of response (Musti-Rao et al., 2008). The researchers used an ABCBC withdrawal design to identify the impact a guided note strategy (B condition) and guided notes combined with RCs (C condition). The RCs consisted of mini dry erase boards, and a frequency count of the number of responses was used to track the target students during all conditions of the experiment (Musti-Rao et al., 2008). In the baseline condition and guided note conditions, participation was defined as SSR, while written responses on whiteboards constituted participation in the RC condition (Musti-Rao et al., 2008). The average

response rate of students in the baseline condition was 1.8 responses per student. This increased to 2.4 during Condition B and again increased to 33 during Condition C. The return to Condition B resulted in a decrease to 1.2 responses per student and then increased again during the return to Condition C, though only to 8 responses per student (Musti-Rao et al., 2008). During guided note sessions, the group participation rate was 2.6% and improved to 32.6% when RCs were introduced, though the two RC conditions were inconsistent. The researchers noted that this discrepancy could be due to a number of questions that were not designed to be very conducive to RC use (Musti-Rao et al., 2008). Though results were mixed between the two RC sessions, this study reveals a potentially significant benefit of increased student participation.

Lambert et al. (2006) studied two fourth-grade classrooms, focusing on 9 students who were identified by teachers as disruptive and at risk of failure. The researchers trained the two teachers on keeping lessons moderately paced and directing students to utilize their RCs to answer questions. They used an ABAB format to observe students and their disruptive behaviors and on-task behaviors under the condition of SSR and under the RC condition (Lambert et al., 2006). The study found that disruptive behavior decreased as students were more on-task during the RC conditions. When reverting back to the SSR condition, disruptive behaviors increased while on-task behaviors decreased. All students in this study exhibited significantly more on-task behavior under the RC condition. Lambert at al. (2006) suppose this result may be due to the high response rates for students during the RC condition, which required them to pay attention and gave ample opportunities for actively responding to teacher questions via their white boards.

Christle and Schuster (2003) also examined the effects of RCs in a fourth grade classroom, focusing on 5 students from a class of 24 who were representative of the class's range in participation level and skill in math. The researchers used a single-subject ABA design with condition A the baseline condition involving SSR and condition B the experimental condition involving RC. The RC in this experiment was a file folder cut to fit into a plastic sheet protector which students wrote on with dry erase markers (Christle & Schuster, 2003). The teacher asked questions as part of each lesson in both conditions. The researchers tracked the number of student-initiated response opportunities and on-task behavior for the target students across conditions (Christle & Schuster, 2003). The student-initiated response opportunities are broken down by student:

Student 1 – 0% in SSR 1, 97% in RC, 0% in SSR 2
Student 2 – 100% SSR 1, 100% RC, 100% SSR 2
Student 3 – 70.8% SSR 1, 100% RC, 38.6% SSR 2
Student 4 – 25% SSR 1, 100% RC, 38.6% SSR 2
Student 5 – 63.3% SSR 1, 100% RC, 44.2% SSR 2

Besides the one student who consistently participated for each question in each condition, students showed a significant improvement in participation when in the RC condition over the SSR condition, most dramatically with one student who did not participate at any point during the SSR conditions (Christle & Schuster, 2003). The percentage of on-task behavior also improved significantly with the use of RC, as can be seen in the following data:

Student 1 – 12.5% SSR 1, 100% RC, 57.6% SSR 2
Student 2 – 45.8% SSR 1, 100% RC, 64.6% SSR 2
Student 3 – 54.3% SSR 1, 91% RC, 64.6% SSR 2

Student 4 – 37.5% SSR 1, 96% RC, 42.3% SSR 2

Student 5 – 70.8% SSR 1, 100% RC, 60% SSR 2

All target students showed highly significant improvements in on-task behavior during the RC condition, and all but one student showed slight improvements in the second SSR condition compared to the first (Christle & Schuster, 2003). The researchers determined that their study suggested that RC was effective for increasing student participation in this setting (Christle & Schuster, 2003).

Adamson and Lewis (2017) recognized that research on the impact of specific strategies and interventions was much more prevalent at the elementary level than at the secondary level and sought to identify the impact of three SRS strategies on students' participation rates. In this study, the research includes three teacher-student pairs from one public high school who were willing to participate in the experiment. To be included in the study, students needed to be diagnosed with a disability, be failing or in danger of failing a core class, and have documented behavior issues, and teachers needed to be willing to increase opportunities for students to respond and to include multiple forms in a given class period. All three students were diagnosed with ADHD (Adamson & Lewis, 2017). Teachers incorporated guided notes, class wide peer tutoring, and RCs in correlation with an alternating treatments design. Teachers were trained on the strategies, and direct observation was used to examine the impact of each of these on student participation (Adamson & Lewis, 2017). Teachers administered the three designs in random order and incorporated the most effective method during the final intervention phase. Duration recording was used to capture actively engaged and off task behavior, while frequency recording was used to track disruptive behaviors (Adamson & Lewis,

2017). The study found that all three students exhibited infrequent active engagement or participation and displayed instances of disruptive behavior. The implementation of opportunity to respond strategies resulted in higher rates of participation and active engagement (Adamson & Lewis, 2017). In addition, instances of disruption decreased for all three students during the intervention and showed an even more significant decrease when the most effective treatment was repeated in the final phase of the intervention (Adamson & Lewis, 2017).

A prior RC study found similar increases in active participation. Gardner, Heward, and Grossi (1994) examined response rates in a fifth grade science classroom of 22 students in a low socioeconomic area. Five students were targeted for the study and put into two groups. The researchers used an ABAB reversal design to examine the impact on both experimental groups (Gardner et al., 1994). Each lesson was divided into three parts with the first part being a quiz on the previous day's material, the second part including new information presented via projector, and the third part consisting of review questions of the day's concepts. The teacher alternated between SSR procedures and the use of RCs. Students were trained on both methods and practiced them prior to the start of observation (Gardner et al., 1994). In the SSR sessions, the teacher would call on one student to answer each question and provide corrective feedback when necessary. During the RC sessions, students wrote short answers on their boards and held them up for the teacher to scan responses. In these sessions, the teacher would also provide corrective feedback when necessary (Gardner et al., 1994). The results of this study showed significant improvement in participation in the RC study with an average response rate of

21.8 over an average of 9.9 in the SSR sessions. As a group, the students responded 53 times out of 1, 103 questions with SSR and 678 times out of 1,015 with RCs (Gardner et al., 1994). Overall, the use of RCs significantly increased the rates of participation for all students chosen for the study (Gardner et al., 1994).

Maheady, Michielli-Pendl, Mallette, and Harper (2002) found similar benefits to RC use when compared with traditional SSR as well as other active response strategies. Using an alternating treatments design, the researchers sought to examine the effects of three response strategies on the participation rates of 21 sixth grade students in a science classroom (Maheady et al., 2002). The strategies included RC in the form of small dry-erase boards; the Numbered Heads Together (NHT) strategy, which includes heterogeneous grouping and allows small groups to work together to create a response to teacher questions; and Whole Group Question and Answer, a form of SSR, which provided the baseline measure. During each session of the experiment, the teacher announced which strategy would be used for that lesson, and students prepared accordingly (Maheady et al., 2002). The researchers used direct observation and a Questioning Event Recording Form to capture data on the number of students who responded appropriately to the questions, either by raising hands or using RC. Visual scans were used to track how many students were on task (Maheady et al., 2002). The results of this study showed significant difference in participation rates with each condition. During SSR, 15% of students on average usually volunteered to answer each question by raising their hands (Maheady et al., 2002). This presented a stark contrast to the RC condition where an average of 85% of students were actively responding to each

question. During the NHT strategy, nearly every "designated team member" responded to each question, with an average response rate of 98% (Maheady et al., 2002). On-task rates were also significantly increased during the experimental conditions. The rates of on-task behavior during the SSR condition stayed mostly between 70% and 80%, under they averaged 90% under the RC condition and 98% using NHT (Maheady et al., 2002). Both the RC and NHT strategies were found to be more effective than SSR by improving both rates of participation and on-task behavior. Students preferred these strategies as well, which may have contributed to these high participation results (Maheady et al., 2002).

Randolph (2007) conducted a meta-analysis of research on RC and its impact on participation and off-task behavior. The researcher identified the controversy over RC effectiveness and noted that while replicating studies may be a better way to determine if results from previous studies can be generalized, it was also important to conduct the meta-analysis due to the amount of studies that fit the criteria and their intricacies (Randolph, 2007). This study utilized several databases to acquire records of a multitude of studies on RC use in classrooms. The RC use served as the independent variable of the study and could either be pre-printed or write-on versions (Randolph, 2007). The control condition across studies included the SSR method. The dependent variables of participation and off-task behavior were monitored across the studies (Randolph, 2007). Multiple academic areas and grade levels, including k-12 and college level, were included, and the designs accepted for inclusion were ABAB, ABA, and alternating treatment designs. The study included a total of 29 papers that met all criteria (Randolph,

2007). The meta-analysis resulted in the conclusion that RC linked to improved participation by 50% over SSR. In addition, a 35% drop in off-task behavior was found when RC conditions were in use (Randolph, 2007). The researcher identified these results as support for the theory that increased student participation leads to increased learning and decreased off-task behavior (Randolph, 2007).

Low-Technology Student Response Systems and Student Achievement

Gardner et al. (1994) not only documented the impact of RCs on participation in a fifth grade science classroom but also examined the effects this strategy had on academic achievement. In addition to observing participation rates during SSR and RC sessions, students' quiz scores during each of these sessions were examined. After the first session, 16-question quizzes were given at the start of each lesson to assess students' retention of the previous day's information (Gardner et al., 1994). 40-question review tests were also administered every two weeks during the intervention. Each covered an equal amount of material from prior lessons (Gardner et al., 1994). The results of this study included significant gains in academic achievement under the RC condition. 21 out of the 22 students in the class performed better on quizzes during the first RC session, with an average score of 70%, than in the first SSR session, with an average score of 59%. Scores decreased in the following SSR session, to 50%, and increased again in the second RC session to 70% (Gardner et al., 1994). The same result was found in the review test scores. The average test score during SSR sessions was 49%, while the average during RC sessions was 70% (Gardner et al., 1994). Not only did the review test scores support the suggestion based on quiz scores that RCs improved students' academic performance,

but they also showed that the impact of the RC sessions was maintained over time (Gardner et al., 1994).

Christle and Schuster (2003) also found positive associations between RC and academic achievement of elementary students. In their study of 5 target students in a fourth-grade math class, they used an ABA single-subject design to monitor the effects of RC on student performance on weekly quizzes (Christle & Schuster, 2003). Condition A consisted of traditional SSR to questions given by the teacher, while condition B was the RC condition, where students used file folders inside plastic sheet protectors to write responses to the questions and answer by holding them up when prompted. The target students' average quiz scores are broken down individually:

Student 1 – 63% SSR 1, 93% RC, 63% SSR 2
Student 2 – 97% SSR 1, 100% RC, 100% SSR 2
Student 3 – 87% SSR 1, 100% RC, 92% SSR 2
Student 4 – 87% SSR 1, 93% RC, 63% SSR 2
Student 5 – 90% SSR 1, 96% RC, 58% SSR 1

All target students showed some level of improvement in their quiz scores after the RC condition compared to the SSR conditions (Christle & Schuster, 2003). The researchers found RC to be an effective strategy for improving student achievement in this setting. They considered possible effects of the RC to be increased involvement in the lessons, which may have caused the improved quiz scores during RC condition. They also noted that the RC condition increased the teacher's ability to utilize formative assessment to guide future lessons and to give immediate feedback to students after viewing responses.

These conditions could also account for the increase in quiz scores (Christle & Schuster, 2003).

Another study on elementary school students by Maheady et al. (2002) found a positive correlation between the use of RC and student academic performance. In this study, the researchers observed a sixth-grade science class to examine the effects of two active response strategies as compared with whole group questioning and SSR. In their study, the researchers tracked not only the participation rates during SSR, RC and NHT strategies as previously discussed, but they also examined their scores on daily 10-question quizzes under each of the three conditions (Maheady et al., 2002). Through the alternating treatments design, the researchers found that during the RC and NHT conditions, quiz scores were almost always higher than during the SSR condition. While quiz scores averaged 73.2% in the whole group questioning condition, scores averaged 81.6% in the first NHT session and 81.5% in the first RC session. During the second session of RC and NHT, quiz scores increased to an average of 86% in both conditions (Maheady et al., 2002). 11 out of 21 students scored their highest quiz grade under the RC condition, while the other 10 students achieved their highest score when NHT was used. There were only 4 students who had a quiz score during whole group that was higher than one of the experimental conditions (Maheady et al., 2002). During both RC and NHT conditions, 48% of the class scored A's and previous rates of failure were decreased by half. A dramatic difference was also found between pretest and posttest scores, which jumped from an average of 20.4% to 78.8% after the intervention (Maheady et al., 2002). It was determined that RC and NHT were both more effective

than whole group SSR at improving student performance in this setting, resulting in the class quiz average being about one letter grade higher during experimental conditions (Maheady et al., 2002).

The previous study confirms the findings of Cavanaugh, Heward, and Donelson (1996) who studied the impact of passive review and active review using RC (dry-erase boards) on the test scores of a high school science class. Twenty-three ninth graders participated in this study, eight of whom were diagnosed with disabilities. The researchers utilized an alternating treatments design to examine the effects of the two review strategies. The data consisted of 30 next-day tests and 11 weekly tests (Cavanaugh et al., 1996). The passive review strategy involved the teacher explaining the key concepts that had been presented in the lesson and giving examples while students listened and viewed the information on a projector. For the RC condition, a blank was left in the description of each concept or term which students tried to fill by writing the missing word on the RC and holding it up on command. The teacher then gave the answer and provided necessary feedback (Cavanaugh et al., 1996). The evidence showed that almost all students in the class scored higher on next-day tests when RC had been used. Weekly test scores for items reviewed using RC were also higher than in the passive review condition (Cavanaugh et al., 1996). The researchers attributed these results to the active quality of responding in the RC condition, the physical writing which corresponded to test tasks, and the opportunity for feedback provided during RC use (Cavanaugh et al., 1996).

Clayton & Woodard (2007) studied the effect of RCs on student achievement in at the university level. In their study of 120 psychology students using file folder RCs to answer true/false review questions, the researchers also tracked quiz scores to identify changes from the baseline condition to the RC condition (Clayton & Woodard, 2007). Quizzes were electronically graded and were kept the same across both the control section and the experimental section. Quizzes were given each week during the semester (Clayton & Woodard, 2007). The study found that both sections of the course had similar quiz scores during the baseline condition. During the experimental condition, the RC group scored slightly higher on the weekly quizzes (Clayton & Woodard, 2007). A confusing result was that the final quiz in the experimental condition showed lower scores in both sections of the course. The researchers suggest this may be due to a poorly designed quiz or more difficult chapters for students to understand. Also unexpected, quiz scores of the experimental group dropped lower than those of the control group when the RC condition was removed (Clayton & Woodard, 2007). The researchers did find evidence that the RC treatment aided students in their understanding of the content. The rate of students receiving A's on their quizzes more than doubled at the start of the RC condition to 21%. During this time, the rate of students receiving A's in the control section remained around 12% (Clayton & Woodard, 2007). The researchers interpreted this data to suggest that the use of the RC condition elevated B-earning students to receiving A's, while students scoring below a B experienced unclear benefits from the RC treatment (Clayton & Woodard, 2007).

Musti-Rao et al. (2008) also found mixed results for the impact of RCs on academic achievement. Their study of 19 undergraduate students in a special education course involved both the introduction of guided notes and the use of guided notes and dry erase RCs in an ABCBC design. The researchers collected scores on quizzes given most class periods as a measure of student achievement (Musti-Rao et al., 2008). Quizzes were given at the beginning of the class period and required students to answer questions about material from the previous lesson. Quizzes ranged from 7 to 10 questions and consisted of multiple choice and true/false question formats (Musti-Rao et al., 2008). The average quiz score across the 5 target students during the baseline condition was 71.7%, which improved to 82.2% upon the intervention condition of guided notes (Condition B). In the guided note and RC condition (Condition C), the average score was 79%. This average varied little with the return to Condition B, which was 79.5%, but increased again when returning to Condition C with 84% (Musti-Rao et al., 2008). Overall, a 9.1% increase in scores was shown between the baseline condition and the experimental conditions, though scores did not change consistently with each condition in the experiment. The researchers noted that though students preferred the guided note condition, neither this condition nor the RC condition showed significant improvements to student achievement (Musti-Rao et al., 2008).

Another study by Malanga and Sweeney (2008) found mixed results with RC use at the undergraduate level. This study examined the effect of both daily assessment and RC on weekly quiz scores in two sections of applied behavior analysis course. The average of the students' weekly quiz scores (24 in one section and 27 in the other) were

included in the data (Malanga & Sweeney, 2008). The independent variables in this study were pre-printed RC and daily assessments consisting of 5 short answer questions. An alternating treatments design was utilized in this study due to the ability to reveal a functional relationship in a reduced amount of time than with a more lengthy reversal design (Malanga & Sweeney, 2008). The researchers found that quiz scores increased at the beginning of both experimental conditions but that there was a more significant increase under the daily assessment condition than the RC condition. A slight drop in scores was noticed when moving from the daily assessment condition to the RC (Malanga & Sweeney, 2008). The evidence across the two course sections was consistent. Scores under daily assessment were higher in both classes than under the RC condition (Malanga & Sweeney, 2008). More apparent improvements can be seen when looking at individual scores. For example, quiz scores on the lower end of the class range improved under both conditions for both classes (Malanga & Sweeney, 2008). When examined another way, the highest rate of students earning 90% or higher was seen under the daily assessment condition. This rate under the RC condition was found to be lower than the baseline condition (Malanga & Sweeney, 2008). While the results were mixed, the study still achieved several important conclusions including adding to the foundation of evidence for the effectiveness of strategies that promote active student responding (Malanga & Sweeney, 2008).

Randolph (2007) conducted a meta-analysis on the effects of RC not only on participation but also test and quiz achievement. Twenty-nine papers were included in this study which met eight different points of criteria. Multiple academic fields and grade

levels were included from kindergarten to college level. Included studies followed either an ABAB, ABA, or alternating treatments design (Randolph, 2007). The researcher found that the RC condition showed increased performance over the SSR condition in all categories. On average, quiz scores were 1.08 *SD* and test scores were .38 *SD* higher in the RC condition. The researcher supposed that time interval between lessons and quizzes typically being shorter than the interval between lessons and tests may account for the different increase. It was considered that this discrepancy could also relate to the quality of the tests themselves (Randolph, 2007). Overall, the researcher identified a positive association between RC conditions and improved test and quiz scores of students (Randolph, 2007).

Mini Whiteboards

Though some of the research on the impact of mini whiteboards is mixed, there is an overwhelming amount of evidence that supports positive associations on both student participation and academic performance. Musti-Rao et al. (2008) found in a study of undergraduate students that the use of mini whiteboards had a positive effect on participation and on-task behavior but found no significant impact on the academic performance of students. Lambert et al. (2006) found a similar improvement on participation in a study of two fourth grade classrooms. Christle and Schuster (2003) also studied a fourth grade classroom and found mini whiteboards to increase both participation and on-task behavior as well as quiz scores. Similarly, Gardner et al. (1994) studied a fifth grade classroom and noted increased participation and academic performance with mini whiteboard use. Maheady et al. (2002) conducted a study with a

sixth grade class using mini whiteboards and the NHT strategy. They found that both strategies showed increased participation and on task behavior as well as improved test scores over the SSR condition (Maheady et al., 2002). Similarly, Cavenaugh et al. (1996) studied ninth grade students and noted increased test scores when mini whiteboards were used. With only one study showing mixed results, it is clear that mini whiteboards can have a significant positive impact on students' participation rates and academic performance.

Conclusion

This review of literature details the present research on the use of SRS in various classrooms and its effectiveness for improving participation and academic performance, the importance of increasing participation and academic performance of students with attention issues, and the opportunities for improvement from the individual SRS of mini whiteboards. Common recommendations among the studies reviewed include the use of clickers to improve student participation and academic performance (Preszler et al., 2006; Penuel et al., 2007; Stowell & Nelson, 2007; Kay & LeSage, 2009; Fallon & Forrest, 2011; Heaslip et al., 2013; Tlhoaele et al., 2014). More research may be needed to determine the true benefits of clickers versus the benefits of clicker friendly pedagogy (Fies & Marshall, 2006; Trees & Jackson, 2007; Hunsu et al., 2016; Green, 2016; Brady et al., 2013; Lasry, 2008; Anthis, 2011; Dallaire, 2011; Kulesza et al., 2014). While technological SRS have shown positive impacts on student engagement and performance, low-technology SRS has also been linked to many of these improvements (Nagro et al., 2016; Clayton & Woodard, 2007; Musti-Rao et al., 2008; Lambert et al., 2006; Christle

& Schuster, 2003; Adamson & Lewis, 2007; Gardner et al., 1994; Maheady et al., 2002; Randolph, 2007; Cavanaugh et al., 1996).

This study aims to add to the current research on low-technology SRS by investigating the use of the individual SRS of mini whiteboards with students in a tenth grade resource center English classroom. Teacher created questions and prompts posed to the class will serve as formative assessment during guided practice prior to students beginning independent work. The purpose of this study is to: (a) examine the effectiveness of mini whiteboards in increasing participation rates of students in a tenth grade resource class English classroom, (b) examine the effectiveness of mini whiteboards in improving the academic achievement of students in a tenth grade resource class English classroom, and (c) determine if students in a tenth grade resource class English classroom are satisfied with the use of mini whiteboards.

Chapter 3

Methodology

Setting

School. The study was conducted in a public high school located in a suburban/rural area of South Jersey. The school district consists of one middle school and one regional high school. Students reach Kingsway district either at seventh grade from one of the sending district elementary schools or at ninth grade from Logan Township Middle School. During the 2018-2019 school year, there were approximately 2,739 students enrolled in the school district. The high school served 1,750 students in grades nine through twelve. Of the 439 tenth grade students enrolled, approximately 30 currently receive pull-out resource room instruction in either mathematics or language arts. The academic school day is approximately seven hours long. Class periods are 57 minutes long with four minutes of passing time between each period. The school utilizes a SMART schedule in which class periods are divided into a morning wheel and an afternoon wheel, each containing four class periods but with three seen each day. There are four letter days in the rotation from A-D. In each, three morning classes and three afternoon classes occur with the one hour SMART lunch in between. Each day, one morning and one afternoon class are dropped from the schedule. The schedule works as follows:

A-day – 1, 2, 3, SMART lunch, 6, 7, 8

B-day – 4, 1, 2, SMART lunch, 9, 6, 7

C-day – 3, 4, 1, SMART lunch, 8, 9, 6

D-day – 2, 3, 4, SMART lunch 7, 8, 9

The class that is dropped each day comes first in its respective wheel the following day. In addition, Z-days are periodically included in the schedule. On these days, typically half days, class periods are shortened, and all class periods are seen.

Classroom. The study was conducted in two tenth grade resource room English classes, both occurring in the same classroom in the high school. The classroom consists of twelve student desks, individually spaced in a rectangular arrangement, and a teacher desk. A paraprofessional is present in each class period, and each serves as a teacher assistant for instruction. The front of the classroom has a large chalkboard with a Promethean board placed in the middle. The ceiling projector displays content from the teacher's computer, while the board allows interaction with the content displayed. The back of the classroom includes a medium sized whiteboard and a small bulletin board. A Chromebook cart containing ten devices is kept in a front corner. The cart is shared and does not contain enough devices for all classes, so it may be moved from the room to be used by another teacher, or the teacher using the cart may need to find a Chromebook elsewhere to borrow for the period. The participants in the study were in periods 4 and 6, and classes met each day the period was included in the rotation (for period 4 – B, C, and D-days; for period 6 – A, B, and C-days; both also seen on Z days). In a typical week, classes were seen 3-4 times. The class routine remained unaltered except for the addition of the intervention.

Participants

Students. A total of ten tenth grade students, 2 females and 8 males, with need in the area of engagement and/or academic achievement were included in the study. All of the students were previously identified by the district as having a learning disability and qualifying for special education services. When students are recommended for special education, the Child Study Team conducts or coordinates appropriate testing and examination. If the student is found eligible, they proceed with the process of developing an IEP with the help of parents, general education teachers, special education teachers, and any other necessary personnel, such as a speech pathologist. All students in both class periods had IEPs and were identified as needing pull out resource room instruction for English/Language Arts. The study included five participants from each class. Table 1 provides general participant information.

Table 1

General Participant Information

Student	Age	Gender	English Grade – Semester 1	Classification
1	16y 5m	M	66	CI
2	16y 0m	M	74	SLD
3	16y 2m	F	89	SLD
4	16y 6m	M	88	OHI – ADHD
5	15y 6m	F	92	SLD
6	15y 8m	M	82	OHI – ADHD
7	15y 11m	M	75	OHI
8	15y 9m	M	92	MD
9	15y 7m	M	80	SLD/ADHD
10	15y 8m	M	82	SLD

In the first class, period 4, five students with patterns of low engagement and/or academics participated in the study. Student 1 is a 16 year old Caucasian male. He was found eligible for special education services under the classification of Communication Impaired and has been placed in small group settings for all of his core classes. His strengths include asking for help when needed and seeking opportunities to complete and retake assignments. His weaknesses include following through with these opportunities, being easily distracted in class and distracting others, and completing independent work. Maintaining focus is his greatest challenge. He understands most concepts presented in the ELA classroom but benefits from assistance putting them into practice. He benefits from simplified directions and chunking assignments into small, manageable portions.

Student 2 is a 16 year old mixed race male. He was found eligible for services under SLD in reading comprehension with weaknesses in listening comprehension and oral expression. He has been placed in small group instruction for all of his core classes. His strengths include a very positive attitude which allows him to make friends easily and get along well with his teachers. He also focuses well in class on most occasions and is easy to redirect when needed. His weaknesses include maintaining focus during lecture portions of class and in group work and expressing his understanding effectively both verbally and in writing. He benefits from redirection, assistance with rewording his ideas, and frequent checks for understanding.

Student 3 is a 16 year old Caucasian female. She was found eligible for services under SLD for a functional learning disability and has been placed in small group instruction for English and in-class support for other core subjects. Her strengths include

taking on leadership roles in the classroom, proactively completing schoolwork, in and outside of the classroom, and understanding complex concepts. Her weaknesses include distracting behaviors, writing weaknesses, and a desire to finish work quickly, which may result in poor performance. She benefits from having her work checked over before submitting it and being given jobs to do when she has completed her work.

Student 4 is a 16 year old African American male. He was found eligible for services under Other Health Impaired (OHI) for the diagnosis of ADHD and has been placed in small group instruction for English and math. His strengths include a positive attitude and sense of humor which allow him to get along well with others and a genuine desire to do well in school. He also understands complex concepts and can easily re-explain them in ways that assist the understanding of his peers. His weaknesses include being easily distracted and frequently distracting others by using a loud voice, making jokes, or talking to other students directly. He benefits from redirection and being allowed to socialize with his classmates in a productive way, such as working in a group.

Student 5 is a 15 year old African American female. She was found eligible for services under SLD with difficulties demonstrating comprehension of texts. Her strengths include a very positive attitude, fierce work ethic, organization, and desire to help others. She can always be relied on to have her work completed thoroughly and can often assist others with their work when she is finished. Her weaknesses include a lack of confidence in her understanding of what she has read. She benefits from being allowed to sit near the teacher where she can focus best and being given jobs to do when she is finished her work.

In the second class, period 6, five students with patterns of low engagement and/or academics participated in the study. Student 6 is a 15 year old Caucasian male. He was found eligible for services under OHI for ADHD and academic weaknesses and has been placed in small group instruction for English and math with in-class support in science. His strengths include being a skilled writer who can effectively express himself and his understanding of a text. His weaknesses include disruptive behaviors, being easily distracted by others, and a lack of organization and work ethic. He benefits from one-on-one check ins to make sure he is on track and from assistance with organizing his binder and class materials.

Student 7 is a 15 year old Caucasian male. He was found eligible for services under the title OHI for academic weaknesses and fine motor weaknesses. His strengths include a positive attitude and desire to de well in school as well as the ability to seek out and accept corrective feedback. He benefits from having tasks broken down into manageable section, pre-writing opportunities, checks for understanding, and having his work looked over before submission. He also benefits from assistance with organization and positive reinforcement.

Student 8 is a 15 year old Caucasian male. He was found eligible for services under the title Multiply Disabled for academic weaknesses, executive function skill deficit syndrome, ADHD, and behavior difficulties. His strengths include high intelligence and ability to think deeply about many topics as well as a sense of humor that helps him cope with struggles. His weaknesses include disruptive/aggressive behaviors,

poor work ethic, and issues with authority figures. He benefits from being given opportunities to explain a lesson or concept in his own way to help him understand it.

Student 9 is a 15 year old Caucasian male. He was found eligible for services under SLD in basic reading skills and fluency (Dyslexia) and ADHD combined type. His strengths include a desire to do well in school, the ability to internalize feedback and use it to inform his work on future assignments, and a willingness to participate in class. He benefits from redirection as needed, frequent checks for understanding, listening to text read aloud, and having an opportunity to have work reviewed before submission.

Student 10 is a 15 year old African American male. He was found eligible for services under SLD and has been placed in small group instruction for English and social studies with in-class support for math and science. His strengths include a positive attitude and desire to do well in school. His weaknesses include difficulty understanding complex concepts and the deeper meaning of texts, expressing himself in writing, and remaining focused on lessons and classwork for extended periods of time. He benefits from frequent checks for understanding, time and suggestions for revising his writing, and redirection as needed.

Teacher. A certified high school English teacher instructed both classes, periods 4 and 6, for the duration of the study. The teacher is in her 7th year in the education field and 3rd year as a full-time special education English teacher for the district. The teacher is responsible for creating lessons that align with the district curriculum and the NJ state standards for 10th grade English. Two para-professionals were present for instruction, one in each class period. The para-professional for period 4 previously taught Latin for 35

years and has replaced another para-professional who was placed with this class period just a week before the study began. The para-professional for period 6 is new to the district and had been with the class all year.

Materials

The materials used in this study include the 10th grade English textbook, *Literature: The Reader's Choice*, Course 5, published by Glencoe and a shared Chromebook cart that could be reserved for the class as needed. Weekly comprehension quizzes were administered via Google Classroom using the Chromebooks. A timer was used to keep track of minute intervals while completing the daily engagement checklist. Mini white boards, dry erase markers, and erasers were used for student responses during the intervention.

Measurement Materials

Student Engagement Checklist. An observational checklist was developed to monitor student engagement at five minute intervals for each class period. Teacher and para-professional each had a copy of student lists and checked for engagement every five minutes. A slash was placed by any student's name for displaying off-task behavior at each checkpoint. The teacher and para-professional discussed their findings after class, and these results were transferred to the student engagement checklist for each day. A check mark would indicate that a student was displaying on-task behavior at the particular interval, while an 'x' would indicate that a student was displaying off-task behavior at that time. A copy of the engagement checklist can be seen in Figure 1.

Week of: _____ Week #: _____ Day #: _____

Student #	5 Minutes	10 Minutes	15 Minutes	20 Minutes	25 Minutes	30 Minutes	35 Minutes	40 Minutes	45 Minutes	50 Minutes
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Figure 1. Student Engagement Checklist *Version Date: 2/9/2018*

Weekly Comprehension Quizzes. The students completed a ten question assessment on the reading for the current week, worth a total of ten points. The assessment questions served as a review of the content taught and reading done over that week. All assessments were created by the teacher and were administered either on paper or via Google Forms in Google Classroom. Questions ranged from basic recall to analysis of passages from the week's reading.

Student Academic Progress Table. An academic progress table was developed to record student scores from their weekly assessments (see Figure 2).

Week of: _____ Weeks #: _____

Student #	Assessment 1	Assessment 2	Assessment 3	Assessment 4
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Figure 2. Student Academic Progress *Version Date: 2/9/2018*

Student Likert Survey. At the end of the intervention, the participating students completed a survey using a Likert scale regarding their satisfaction with using mini whiteboards. The survey consisted of nine statements in which students selected their level of agreement as strongly agree, agree, neutral, disagree, or strongly disagree.

Questions inquired about the ease and helpfulness of mini whiteboards, as well as whether or not students felt that mini whiteboards helped increase their weekly assessment score and engagement in their learning. The tenth question requested that students share any additional comments regarding the use of mini whiteboards. All student surveys were completed anonymously (see Figure 3).

<u>This survey is anonymous. Do not put your name on this paper.</u>

Use a check mark to select your level of agreement for each statement listed below:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Mini whiteboards were easy to use.					
2. Mini whiteboards were difficult to use.					
3. Using mini whiteboards helped me to better understand what I was learning in class.					
4. Mini whiteboards allowed me to easily work together with my classmates.					
5. I felt comfortable sharing my answers on mini whiteboards.					
6. After using mini whiteboards, I performed better on my daily assignments.					
7. After using mini whiteboards, I was more engaged in my learning.					
8. I enjoyed using mini whiteboards.					
9. I would like to use mini whiteboards in the future.					

10. Please share any additional comments regarding the use of mini whiteboards below:

_____

_____

Figure 3. Likert Scale Student Satisfaction Survey *Version Date: 11/4/2018*

Research Design

The research was conducted using a single-subject design methodology. The study followed an ABAB alternating baseline pattern. During phase A, baseline data was collected for two weeks for both classes. Due to the rotating schedule, each two-week period consisted of eight class periods, as classes are seen 3-4 times per week. This allowed both class periods to be assessed for the same amount of time regardless of the schedule for that calendar week. Baseline data was collected using an observation checklist and students' weekly assessment grades. During phase B, the intervention phase, students used the SRS of mini whiteboards each day during guided practice with close reading. Mini whiteboards served as the independent variable, while student engagement and academic grades served as the dependent variables. Data was collected daily, via the observation checklist, and weekly, using the academic progress table. Mini whiteboards were then removed for one week (four class periods) during the second phase A and were reintroduced for one week (three class periods) during the second phase B. Student engagement was measured through daily teacher and para-professional observation of on-task behaviors every five minutes for the length of each class period. Student academic achievement was measured through weekly assessments related to the concepts and readings done during the week. At the end of the study, students were given a Likert Scale satisfaction survey to provide feedback on the use of mini whiteboards.

Procedures

The research study was implemented over a six week period from February 2019 to April 2019. Prior to the intervention, the students were taught how to use mini

whiteboards for whole class response. They were given the opportunity to practice the technique with the first reading piece of the unit.

Instructional Design. Identical instruction was provided by the teacher in both periods 4 and 6. The groups received the intervention for the same amount of time during each phase though not on the same days due to the alternating SMART schedule. During the baseline/phase A, students participated in guided close reading and ended the class with independent practice of the skill either alone or in pairs. The researcher completed the engagement checklist each class, and students were administered weekly assessments at the end of each three or four period segment.

During the intervention/phase B, students utilized mini whiteboards to respond to questions during and after guided close reading of passages. Questions ranged from recall of events and translating lines of Shakespeare to analyzing for the deeper meaning of passages. Students answered the questions by writing responses on their whiteboards and holding them up when prompted by the teacher. Correct answers were identified, and students were called on to explain why they responded as they did. Students transitioned to independent practice after scenes of the play were completed. During these times, they were asked to annotate passages to closely read them on their own and to respond to written questions about the passages. The researcher and the para-professional completed the engagement checklists over the course of the class period by marking it every five minutes. Students were administered the weekly assessments on every fourth class period. During the first phase B week two and the return to phase B week, only three class periods were available for data gathering due to altered schedules.

Measurement Procedures

Observations. Throughout the class period, from guided practice to independent practice, the researcher and para-professional observed students. A timer was used to check student engagement every five minutes. Student engagement was observed from the researcher at the front of the room and the para-professional at the back. During each interval, a slash was used to indicate off-task behavior while leaving the space blank indicated on-task behavior. After the class period, the data was transferred to the student engagement check list by placing checks next to students who were on-task in each interval and an 'x' next to students who displayed off-task behavior during an interval.

Academic Grades. Students completed a weekly ten question assessment at the end of every fourth class period. Questions related to the reading passages and concepts from the week's lessons. Students took the quiz on paper or used Chromebooks to access the Google Classroom page and completed the assessment via a Google Form, depending on Chromebook cart availability. They were allowed to ask for clarification of questions or to have their assessment read aloud as an accommodation. Students submitted their assessments upon completion.

Survey. At the conclusion of the study, all participants completed a satisfaction survey. All responses were kept anonymous. After reading the survey statements aloud, the teacher gave students privacy to complete their surveys, which were collected by the para-professional.

Data Analysis

Graphs were created to illustrate and visually compare each phase of data collection. Data points for this study occurred 3-4 days per week. Student scores from academic assessments were collected weekly. Student engagement checks were conducted daily at five minute intervals. All data was recorded in a spreadsheet. Both engagement checks and academic scores ranged from 0 to 10 points.

Chapter 4

Results

Engagement

Research question one asked, will the use of mini whiteboards improve student attention and focus of high school students with learning disabilities? Student engagement was evaluated over the course of each class period during the study. An engagement checklist was utilized to record student engagement every five minutes throughout the class period for a total of fifty minutes. A checkmark indicated that students were displaying on-task behavior, while an "x" indicated that students were displaying off-task behavior. The total number of points a student could earn was ten. Means and Standard Deviation (SD) of each student's engagement were calculated and are presented in Tables 2 and 3.

Table 2

Mean and SD of Student Engagement for Period 4

	Baseline 1		**Intervention 1**		**Baseline 2**		**Intervention 2**	
Student	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	7.00	0.04	7.59	0.05	5.75	0.94	7.67	0.19
2	6.75	0.16	8.40	0.36	8.25	0.31	7.00	0.53
3	6.63	0.22	6.34	0.67	9.67	1.02	8.30	0.12
4	7.00	0.04	6.96	0.36	5.25	1.19	7.30	0.38
5	8.00	0.46	9.15	0.73	9.25	0.81	10.00	0.97

Note. Mean and SD out of ten possible points.

Table 3

Mean and SD of Student Engagement for Period 6

	Baseline 1		**Intervention 1**		**Baseline 2**		**Intervention 2**	
Student	Mean	SD	Mean	SD	Mean	SD	Mean	SD
6	7.63	0.44	6.25	0.57	4.50	1.10	7.67	0.07
7	8.50	0.87	8.84	0.73	9.00	1.15	9.00	0.74
8	4.25	1.25	6.75	0.32	6.50	0.10	6.67	0.43
9	5.13	0.81	6.53	0.43	5.50	0.60	6.30	0.61
10	8.25	0.75	8.53	0.58	8.00	0.65	8.00	0.24

Note. Mean and SD out of ten possible points.

In the area of student engagement, the group mean for Period 4 at baseline 1 was 7.08, and the group mean at intervention 1 was 7.69. The group mean at baseline 2 was 7.63, and the group mean at intervention 2 was 8.05. Each intervention phase showed at least a slightly higher group mean than either baseline phase. Students 1 and 5 had intervention means that were higher than their baseline means. Students 2 and 3 had lower means for the second intervention, but all means remained above the initial baseline. Student 4 had a mean that dropped slightly in intervention 1, dropped more in baseline 2, and rose slightly above the initial baseline mean during intervention 2.

In the area of student engagement, the group mean for Period 6 at baseline 1 was 6.75, and the group mean and intervention 1 was 7.38. The group mean at baseline 2 was 6.70, and the group mean at intervention 2 was 7.53. Each intervention phase showed a higher group mean than the preceding baseline phase. The second baseline phase showed a lower group mean than the first, and the second intervention phase showed a lower

group mean than the first. Student 6 had an intervention 1 mean that was lower then baseline 1, which dipped lower in baseline 2 and then rose slightly above the original baseline during intervention 2. Student 7 had a mean that rose higher during intervention 1, rose again during baseline 2, and remained the same at intervention 2. Students 8 and 9 had means that rose from baseline 1 to intervention 1, fell slightly at baseline 2, and rose again at intervention 2. Though the means at intervention 2 were lower than intervention 1, all means remained above the initial baseline. Student 10 had a mean that rose during intervention 1, dropped slightly at baseline 2, and remained the same at intervention 2.

Academic Achievement

Research question two asked, will the use of mini whiteboards increase the academic achievement of high school students with learning disabilities? Student academic achievement was evaluated weekly using a ten question assessment, worth 10 points total, administered at the end of each four-class week. The assessment served as a review of the content taught over the course of that week. Means and SD of each student's academic achievement were calculated and are presented in Tables 4 and 5.

Table 4

Mean and SD of Academic Scores for Period 4

	Baseline 1		**Intervention 1**		**Baseline 2**		**Intervention 2**	
Student	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	5.50	0.90	3.00	1.30	5.00	0.80	6.00	1.00
2	7.00	0.15	6.00	0.20	6.00	0.30	7.00	0.50
3	8.50	0.60	7.50	0.95	8.00	0.70	10.00	1.00
4	7.50	0.10	2.50	1.55	7.00	0.20	9.00	0.50
5	8.00	0.35	9.00	1.70	7.00	0.20	8.00	0.00

Note. Mean and SD out of 10 total possible points

Table 5

Mean and SD of Academic Scores for Period 6

	Baseline 1		**Intervention 1**		**Baseline 2**		**Intervention 2**	
Student	Mean	SD	Mean	SD	Mean	SD	Mean	SD
6	5.00	0.45	5.00	1.00	5.00	0.80	9.00	0.10
7	6.00	0.05	7.00	0.00	6.00	0.30	7.00	0.90
8	8.50	1.30	10.00	1.50	9.00	1.20	10.00	0.60
9	3.50	1.20	5.50	0.75	6.00	0.30	9.00	0.10
10	6.50	0.30	7.50	0.25	7.00	0.20	9.00	0.10

Note. Mean and SD out of 10 total possible points

In the area of academic achievement, the group mean for Period 4 at baseline 1 was 7.30, and the group mean at intervention 1 was 5.60. The group mean at baseline 2 was 6.60, and the group mean at intervention 2 was 8.00. Intervention 1 showed a lower group mean than baseline 1. The group mean was higher at baseline 2 than at intervention 1 and went higher still during intervention 2. All but one student had higher means at intervention 2 than at the original baseline. Students 1, 3, and 4 had means that went down from baseline 1 to intervention 1 but then rose in baseline 2 and rose again during intervention 2. Student 2 had a mean that went down from baseline 1 to intervention 1, stayed the same at baseline 2, and then rose during intervention 2. Student 5 had a mean that went up from baseline 1 to intervention 1, dropped below original baseline at baseline 2, and then rose to original baseline at intervention 2.

The group mean for Period 6 at baseline 1 was 5.90, and the group mean at intervention 1 was 7.00. The group mean at baseline 2 was 6.60, and the group mean at intervention 2 was 8.80. Though the group mean went down from intervention 1 to baseline 2, all means were higher than the original baseline. Unlike Period 4, the group means for Period 6 rose from baseline 1 to intervention 1 and from baseline 2 to intervention 2. The intervention 2 mean was also higher than at intervention 1. Student 6 had means that remained the same from baseline 1 to intervention 1 and baseline 2, finally increasing at intervention 2. Students 7 and 8 had means that rose from baseline 1 to intervention 1, fell slightly at baseline 2, and returned to intervention 1 means during intervention 2. Student 9 showed means that increased across each phase. Student 10 had

a mean that increased from baseline 1 to intervention 1, dropped slightly at baseline 2, and then rose higher at intervention 2.

Individual Results

Student 1 is a 16 year old Caucasian male. He was found eligible for special education services under the classification of Communication Impaired. Figure 4 shows the engagement scores in points for Student 1. During week 1 of baseline, Student 1's mean engagement score was 6.00. During week 2 of baseline, the mean score increased to 8.00 though only two out of four data points were collected due to attendance. During week 1 of intervention 1, when mini whiteboards were implemented, Student one reached a peak daily score of 10 on the second day, but the mean score went down to 7.50 and increased to 7.67 during week 2 of intervention 1. During baseline 2, when mini whiteboards were removed, Student 1's mean dropped to 5.75. During intervention 2, when mini whiteboards were reintroduced, the mean rose to 7.67. As seen in Figure 4, Student 1's engagement scores were highest at the beginning of baseline and the beginning of intervention 1, dropped through intervention 1, dropped further at baseline 2, and then rose back to the intervention 1 mean during intervention 2.

Figure 5 shows the academic scores in points for Student 1. Student 1's academic score during week 1 of baseline 1 was 5.00 and rose to 6.00 in week 2 of baseline 1. During intervention 1, when mini whiteboards were introduced, the academic score dropped to 2.00 in week 1 and rose to 4.00 in week 2. At baseline 2, when mini whiteboards were removed, the score rose to 5.00 and then to 6.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 5, Student 1's academic

scores dropped when the intervention was introduced but rose steadily during the remaining phases where they returned to the highest score from the baseline phase. Student 1's academic scores ranged from as low as 2 points to as high as 6 points.

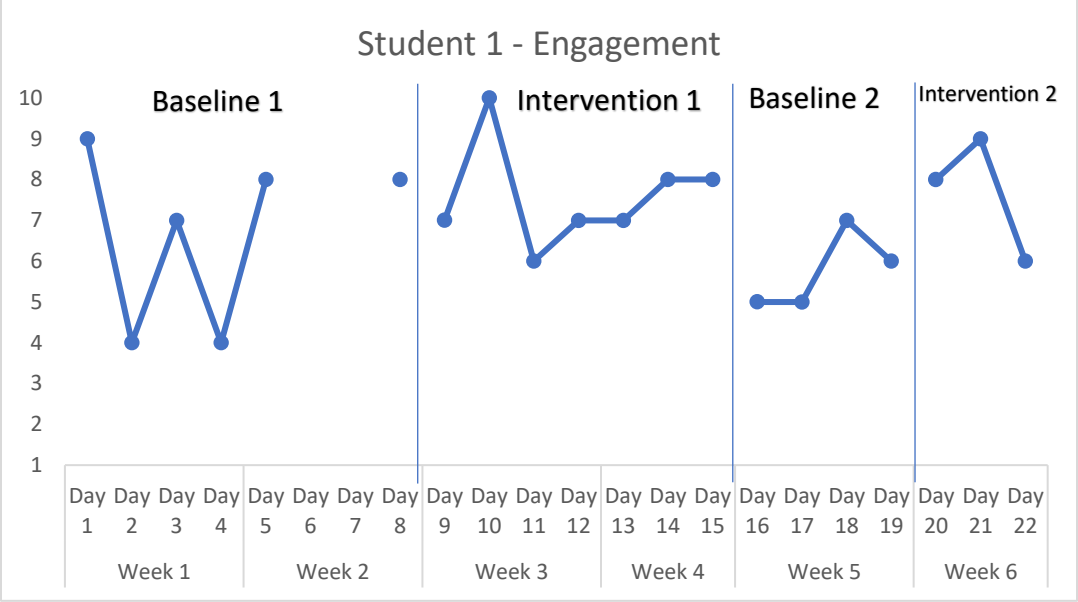

Figure 4. Student 1 Engagement

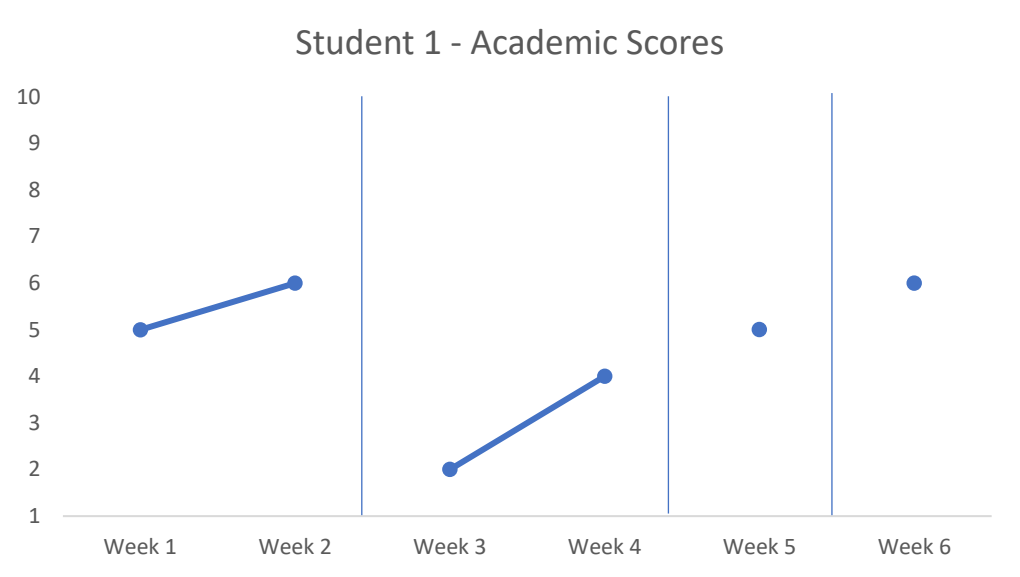

Figure 5. Student 1 Academic Scores

Student 2 is a 16 year old mixed race male. He was found eligible for services under SLD in reading comprehension with weaknesses in listening comprehension and oral expression. Figure 6 shows the engagement scores in points for Student 2. During week 1 of baseline, Student 2's mean engagement score was 7.50. During week 2 of baseline, the mean score decreased to 6.00. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score rose to 7.33 and increased to 9.50 during week 2 of intervention 1. Though only five out of seven data points were collected during intervention 1 due to attendance, a high score of 10 was achieved. During baseline 2, when mini whiteboards were removed, Student 2's mean dropped slightly to 8.25. During intervention, when mini whiteboards were reintroduced, the mean dropped to 7.00. As seen in Figure 6, Student 2's engagement scores peaked in the second week of the first

intervention, dropped slightly at baseline 2, and then dropped again at intervention 2 to a score below the initial baseline.

Figure 7 shows the academic scores in points for Student 2. Student 2's academic score during week 1 of baseline 1 was 7.00 and remained steady through week 2 of baseline 1 and into week 1 of intervention 1, when mini whiteboards were introduced. The academic score dropped to 5.00 in week 2 of intervention 1. At baseline 2, when mini whiteboards were removed, the score rose to 6.00 and then to 7.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 7, Student 2's academic scores remained the same as at baseline when the intervention was introduced but then dropped in the second week. The scores then rose steadily during the remaining phases where they returned to the highest score from the baseline phase. Student 2's academic scores ranged from as low as 5 points to as high as 7 points.

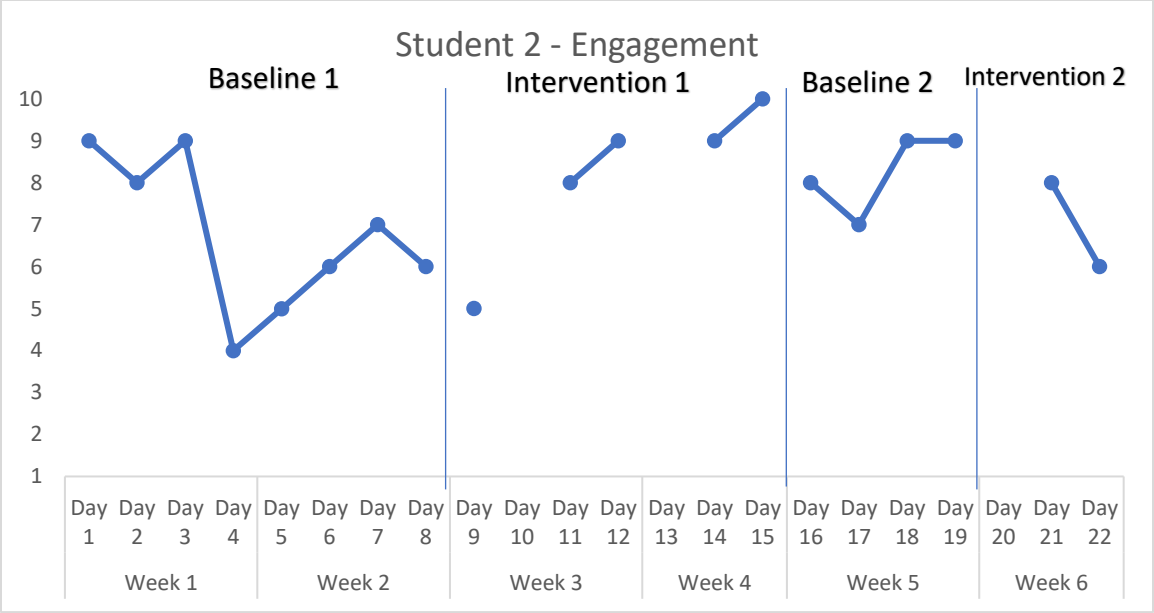

Figure 6. Student 2 Engagement

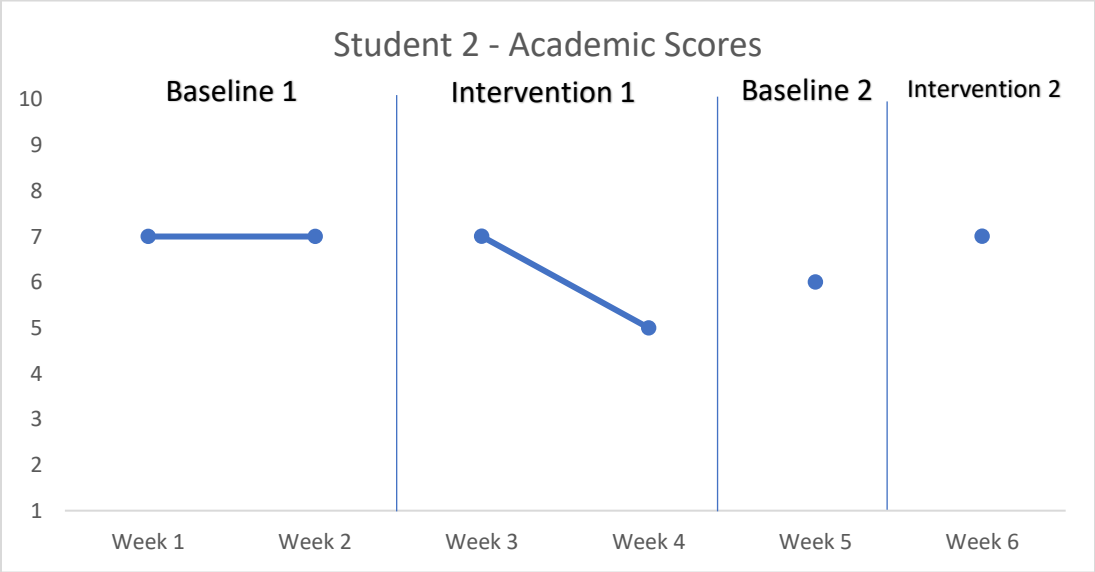

Figure 7. Student 2 Academic Scores

Student 3 is a 16 year old Caucasian female. She was found eligible for services under SLD for a functional learning disability and has been placed in small group instruction for English and in-class support for other core subjects. Figure 8 shows the engagement scores in points for Student 3. During week 1 of baseline, Student 3's mean engagement score was 7.00, though she achieved a high score of 10 on Day 4. During week 2 of baseline, the mean score decreased to 6.25. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score increased to 7.00, though only one data point was collected during this week due to attendance. The mean then decreased to 5.67 during week 2 of intervention 1, including a low daily score of 1. During baseline 2, when mini whiteboards were removed, Student 2's mean rose to 9.67 with three out of four data points collected due to attendance. During intervention 2, when mini whiteboards were reintroduced, the mean dropped to 8.30. As seen in Figure 8, Student 3's engagement scores were up and down through the first two phases then peaked in baseline 2 and dropped slightly during intervention 2.

Figure 9 shows the academic scores in points for Student 3. Student 3's academic score during week 1 of baseline 1 was 8.00 and rose to 9.00 in week 2 of baseline 1. During intervention 1, when mini whiteboards were introduced, the academic score dropped to 6.00 in week 1 and rose to 9.00 in week 2. At baseline 2, when mini whiteboards were removed, the score decreased to 8.00 and then increased to 10.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 9, Student 3's academic scores rose and then dropped when the intervention was introduced

and went up and down during the remaining phases, peaking in intervention 2. Student 3's academic scores ranged from as low as 6 points to as high as 10 points.

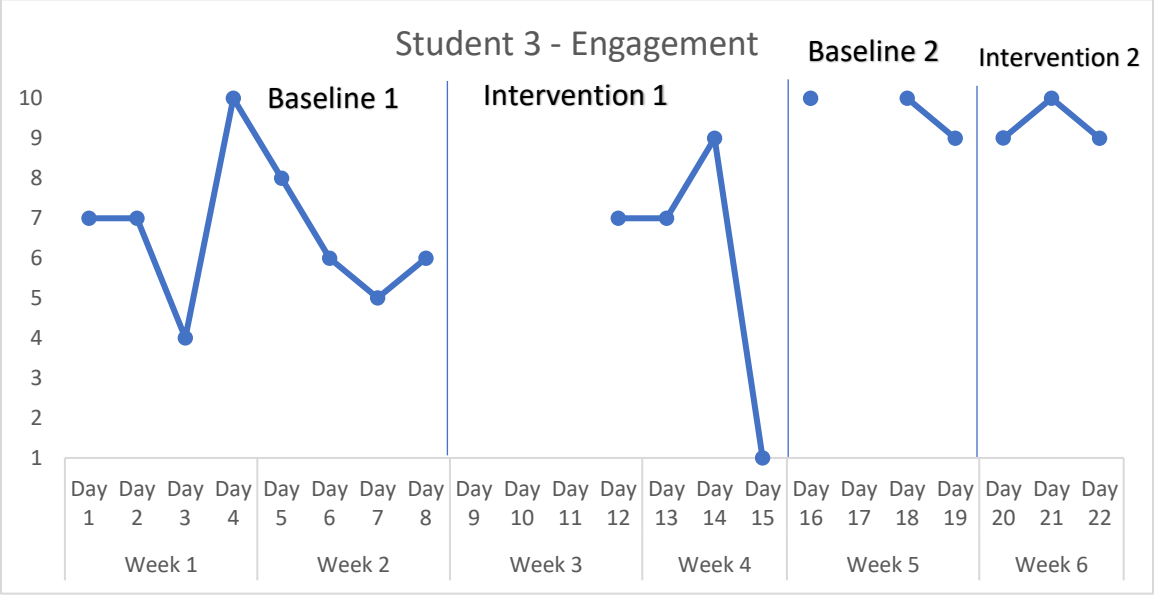

Figure 8. Student 3 Engagement

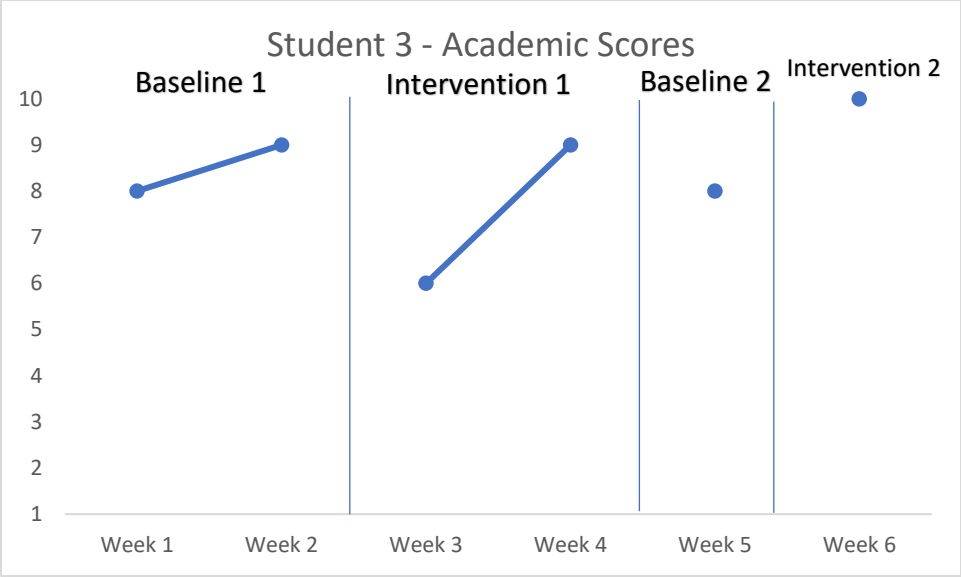

Figure 9. Student 3 Academic Scores

Student 4 is a 16 year old African American male. He was found eligible for services under Other Health Impaired (OHI) for the diagnosis of ADHD and has been placed in small group instruction for English and math. Figure 10 shows the engagement scores in points for Student 4. During week 1 of baseline, Student 4's mean engagement score was 6.50. During week 2 of baseline, the mean score increased to 7.50. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score went down to 6.25 and then increased to 7.67 during week 2 of intervention 1, reaching a high score of 10 on Day 14. During baseline 2, when mini whiteboards were removed, Student 4's mean dropped to 5.25. During intervention 2, when mini whiteboards were reintroduced, the mean rose to 7.30. As seen in Figure 10, Student 4's engagement scores went up and down through baseline and intervention 1, peaked in the second week of

intervention 1, dropped in baseline 2, and then rose back to a level near baseline 1 during intervention 2.

Figure 11 shows the academic scores in points for Student 4. Student 4's academic score during week 1 of baseline 1 was 7.00 and rose to 8.00 in week 2. During intervention 1, when mini whiteboards were introduced, the academic score dropped to 2.00 in week 1 and rose to 3.00 in week 2. At baseline 2, when mini whiteboards were removed, the score rose to 7.00 and then to 9.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 11, Student 4's academic scores dropped significantly when the intervention was introduced but rose steadily during the remaining phases where they exceeded the highest score from the baseline phase at intervention 2. Student 4's academic scores ranged from as low as 2 points to as high as 9 points.

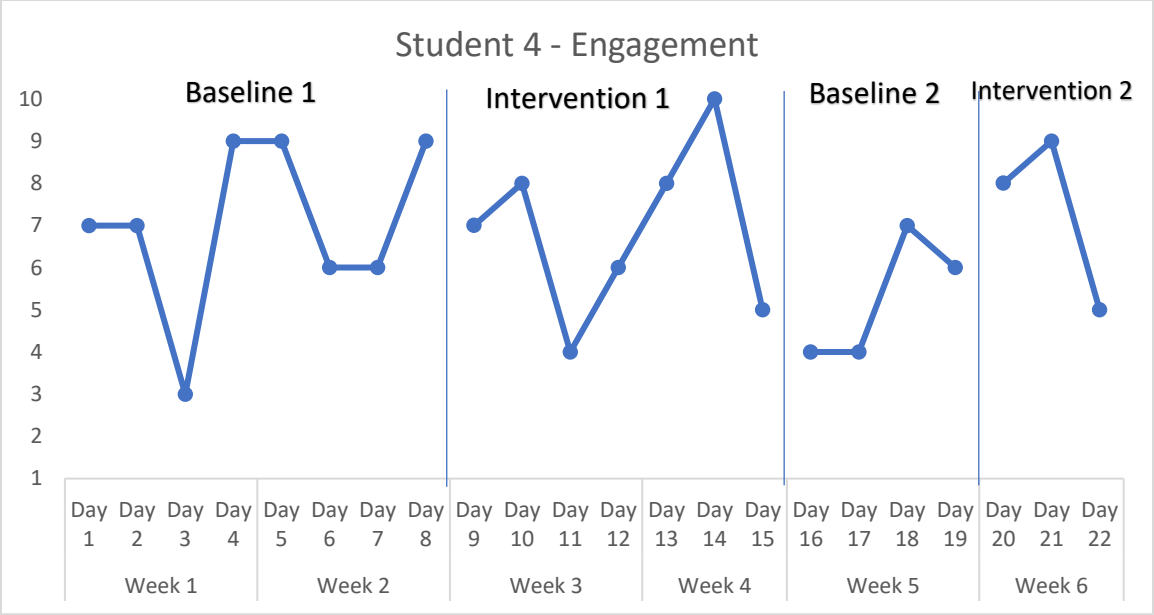

Figure 10. Student 4 Engagement

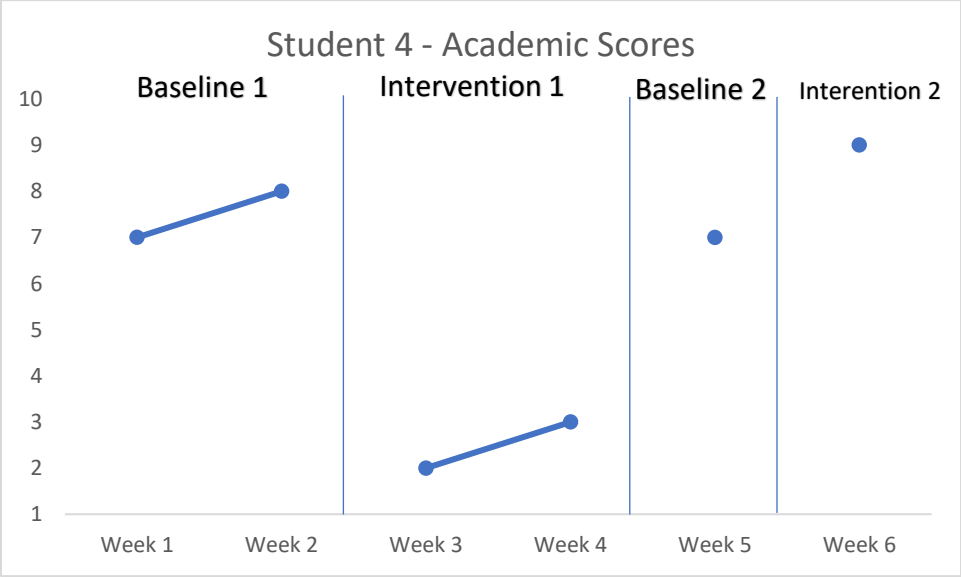

Figure 11. Student 4 Academic Scores

Student 5 is a 15 year old African American female. She was found eligible for services under SLD with difficulties in demonstrating comprehension of texts. Figure 12 shows the engagement scores in points for Student 5. During week 1 of baseline, Student 5's mean engagement score was 9.00. During week 2 of baseline, the mean score decreased to 7.00, with a low daily score of 4 on Day 6. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score went back to 9.00 and increased to 9.33 during week 2 of intervention 1. During baseline 2, when mini whiteboards were removed, Student 5's mean decreased to 9.25. During intervention, when mini whiteboards were reintroduced, the mean rose to 10.00, though only two out of three data points were collected due to attendance. As seen in Figure 12, Student 5's engagement scores decreased in the second week of baseline 1, rose to the initial baseline mean in intervention 1, and continued to increase in week 2 of intervention 1. A slight decrease occurred in baseline 2, but the mean then peaked in intervention 2 with perfect scores of 10.

Figure 13 shows the academic scores in points for Student 5. Student 5's academic score during week 1 of baseline 1 was 7.00 and rose to 9.00 in week 2. During intervention 1, when mini whiteboards were introduced, the academic score increased to 10.00 in week 1 and then decreased to 8.00 in week 2. At baseline 2, when mini whiteboards were removed, the score decreased to 7.00 and then rose to 8.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 13, Student 5's academic scores peaked when the intervention was introduced but then dropped during week 2 of intervention 1 and in baseline 2. The scores then rose slightly in

intervention 2. Student 1's academic scores ranged from as low as 7 points to as high as 10 points.

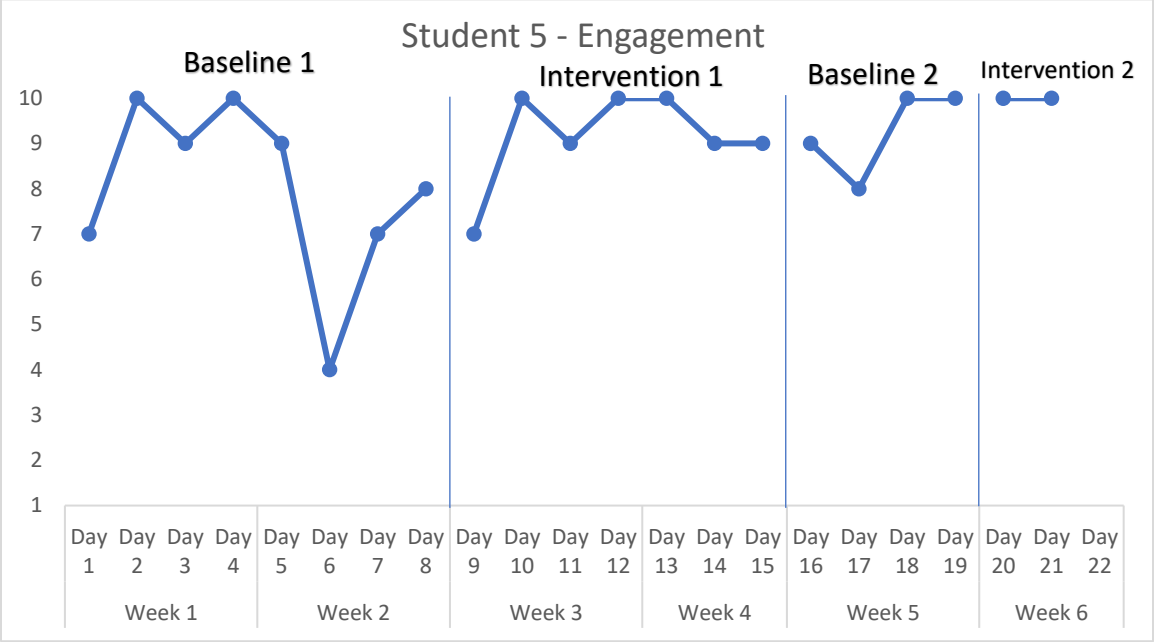

Figure 12. Student 5 Engagement

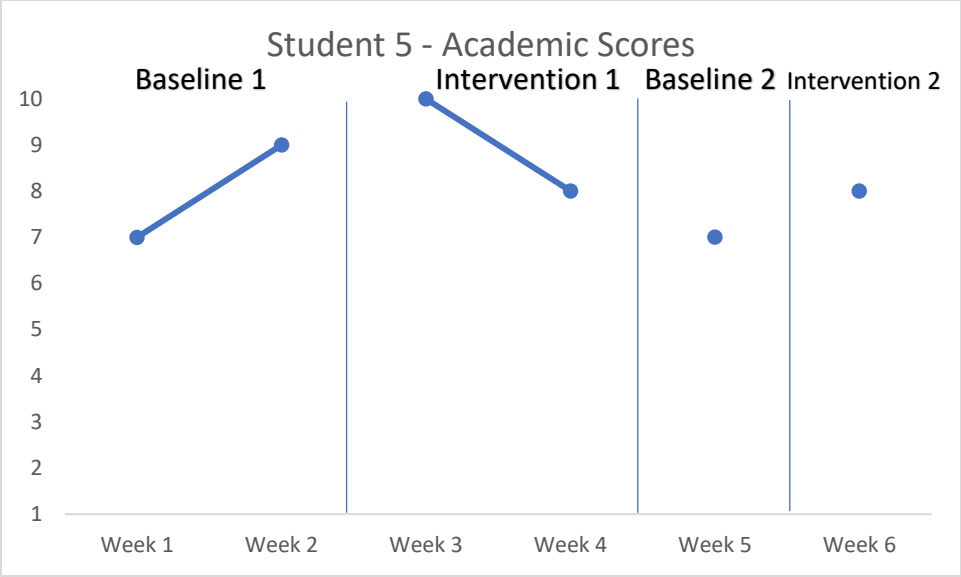

Figure 13. Student 5 Academic Scores

Student 6 is a 15 year old Caucasian male. He was found eligible for services under OHI for ADHD and academic weaknesses and has been placed in small group instruction for English and math with in-class support in science. Figure 14 shows the engagement scores in points for Student 6. During week 1 of baseline, Student 6's mean engagement score was 7.50. During week 2 of baseline, the mean score increased to 7.75 but was more inconsistent with a daily score of 9, two daily scores of 10, and one daily score of 2. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score went down to 5.50 and increased to 7.00 during week 2 of intervention 1. During baseline 2, when mini whiteboards were removed, Student 6's mean dropped to 4.50. During intervention 2, when mini whiteboards were reintroduced, the mean rose to 7.67. As seen in Figure 14, Student 6's engagement scores peaked in the second week of

baseline, dropped and then rose nearly to baseline in intervention 1. The mean dropped further at baseline 2, and then rose back nearly to the height of baseline 1 during intervention 2.

Figure 15 shows the academic scores in points for Student 6. Student 6's academic score during week 1 of baseline 1 was 3.00 and rose to 7.00 in week 2. During intervention 1, when mini whiteboards were introduced, the academic score dropped to 6.00 in week 1 and dropped further to 4.00 in week 2. At baseline 2, when mini whiteboards were removed, the score rose to 5.00 and then to 9.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 15, Student 6's academic scores were up and down through the first three phases and peaked at intervention 2. Student 6's academic scores ranged from as low as 3 points to as high as 9 points.

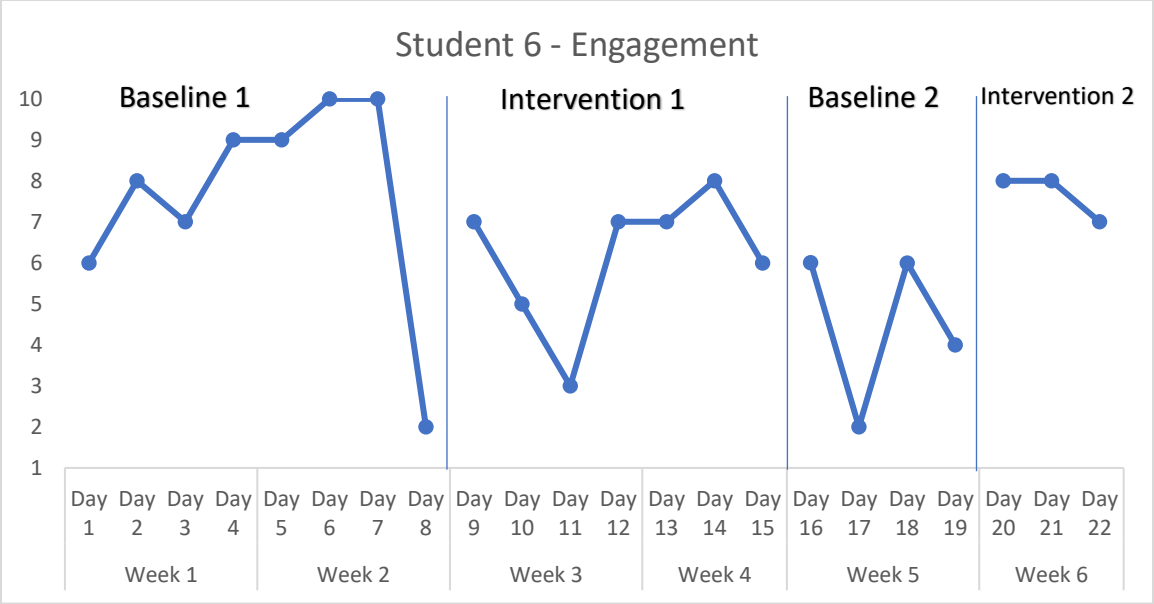

Figure 14. Student 6 Engagement

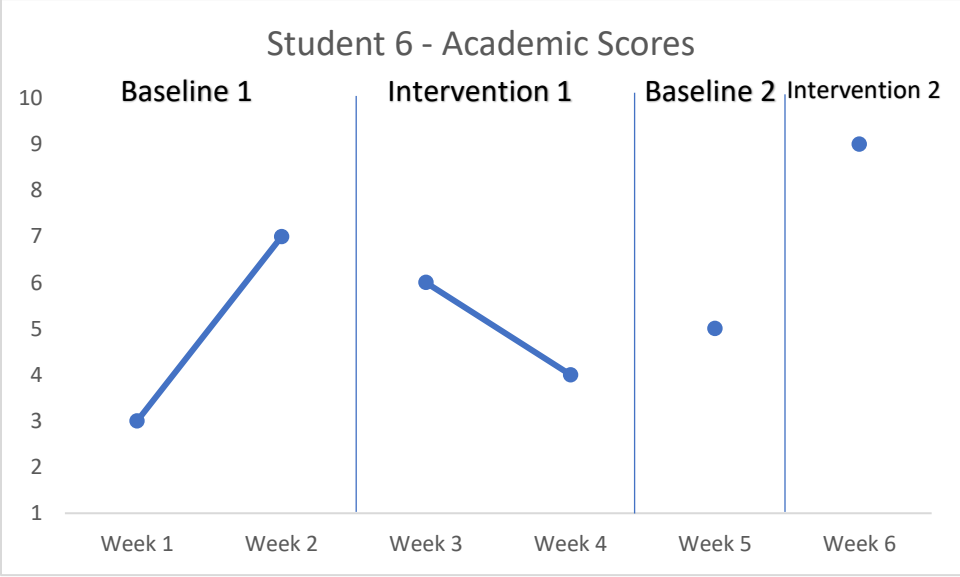

Figure 15. Student 6 Academic Scores

Student 7 is a 15 year old Caucasian male. He was found eligible for services under the title OHI for academic weaknesses and fine motor weaknesses. Figure 16 shows the engagement scores in points for Student 7. During week 1 of baseline, Student 7's mean engagement score was 9.75. During week 2 of baseline, the mean score decreased to 7.25. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score rose to 9.00 then decreased to 8.67 during week 2 of intervention 1. During baseline 2, when mini whiteboards were removed, Student 7's mean rose back to 9.00. During intervention, when mini whiteboards were reintroduced, the mean remained at 9.00. As seen in Figure 16, Student 7's engagement scores peaked in the first week of baseline, went up and down through week 2 of baseline and both weeks of intervention 1, and returned to a score of 9 through baseline and intervention 2.

Figure 17 shows the academic scores in points for Student 7. Student 7's academic score during week 1 of baseline 1 was 7.00 and dropped to 5.00 in week 2. During intervention 1, when mini whiteboards were introduced, the academic score rose to 6.00 in week 1 and then to 8.00 in week 2. At baseline 2, when mini whiteboards were removed, the score dropped to 6.00 and then rose to 7.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 17, Student 7's academic scores rose and then peaked when the intervention was introduced, dropped slightly when returning to baseline, and then rose slightly at intervention 2. Student 7's academic scores ranged from as low as 5 points to as high as 8 points.

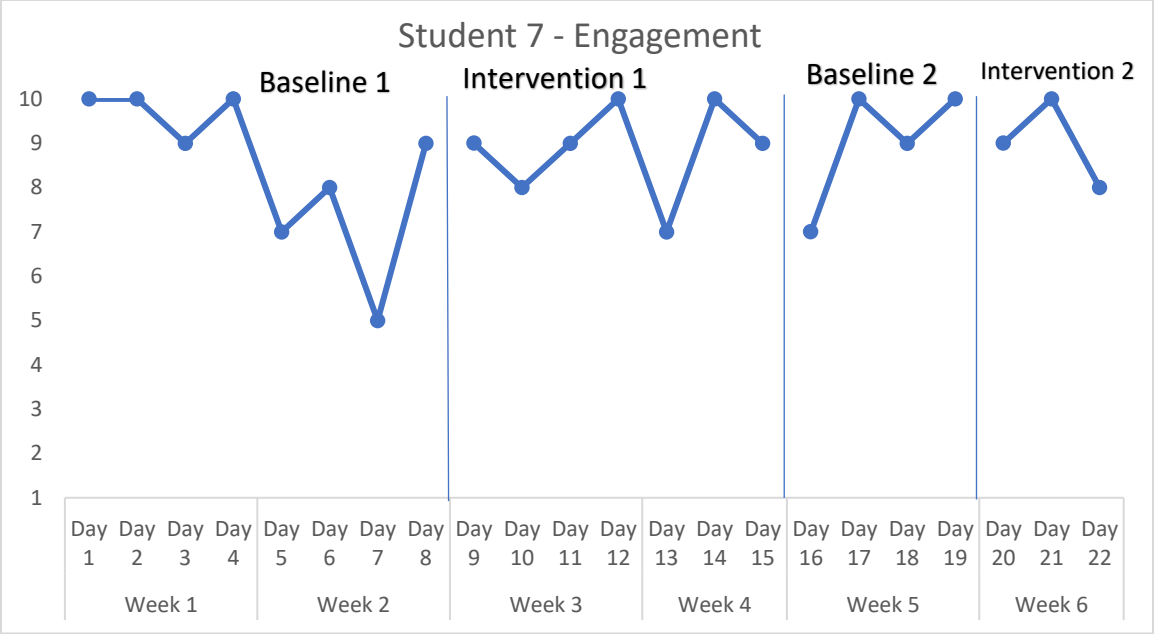

Figure 16. Student 7 Engagement

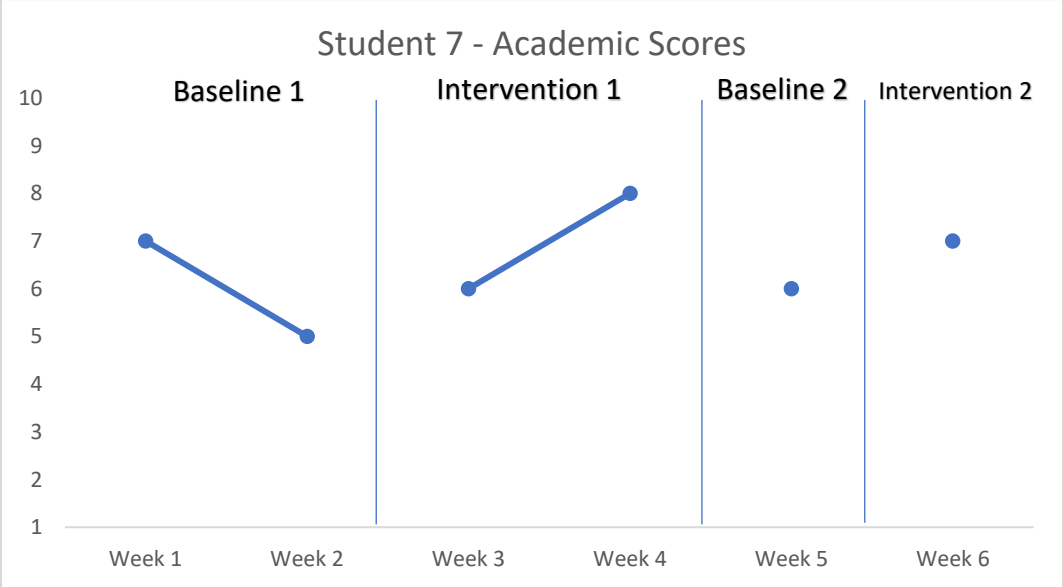

Figure 17. Student 7 Academic Scores

Student 8 is a 15 year old Caucasian male. He was found eligible for services under the title Multiply Disabled for academic weaknesses, executive function skill deficit syndrome, ADHD, and behavior difficulties. Figure 18 shows the engagement scores in points for Student 8. During week 1 of baseline, Student 8's mean engagement score was 4.25, with a high daily score of 8 and low of 2. During week 2 of baseline, the mean score remained at 4.25, with a high daily score of 9 and low of 2. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score increased to 7.50, with a high daily score of 10 on Day 9, and then decreased to 6.00 during week 2 of intervention 1. During baseline 2, when mini whiteboards were removed, Student 8's mean increased to 6.50. During intervention, when mini whiteboards were reintroduced, the mean rose slightly to 6.67. As seen in Figure 18, Student 8's engagement scores rose and peaked in the first week of intervention 1, dropped slightly in the second week of intervention 1, rose slightly at baseline 2, and then rose a bit more during intervention 2. All means after the initial baseline remained above the initial baseline scores.

Figure 19 shows the academic scores in points for Student 8. Student 8's academic score during week 1 of baseline 1 was 9.00 and decreased to 8.00 in week 2. During intervention 1, when mini whiteboards were introduced, the academic score increased to 10.00 in both weeks 1 and 2. At baseline 2, when mini whiteboards were removed, the score decreased to 9.00 and then rose back to 10.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 19, Student 8's academic scores were high during initial baseline but rose to a perfect 10 points when intervention was introduced. The mean then decreased slightly during baseline 2 and went back to a

perfect 10 in intervention 2. Student 8's academic scores ranged from as low as 8 points to as high as 10 points.

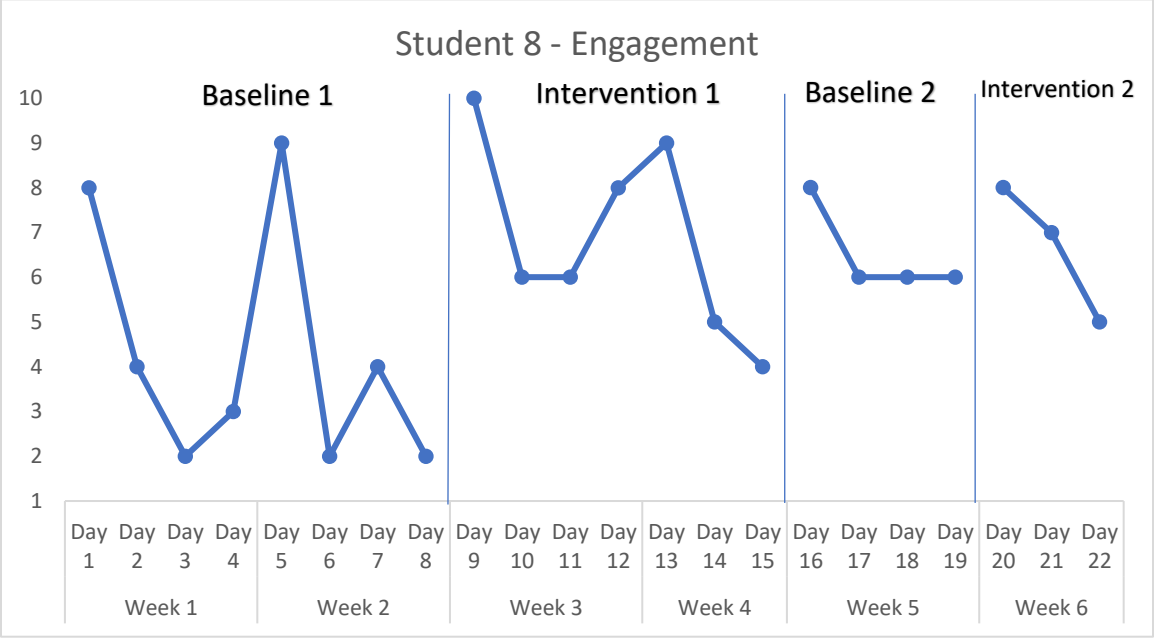

Figure 18. Student 8 Engagement

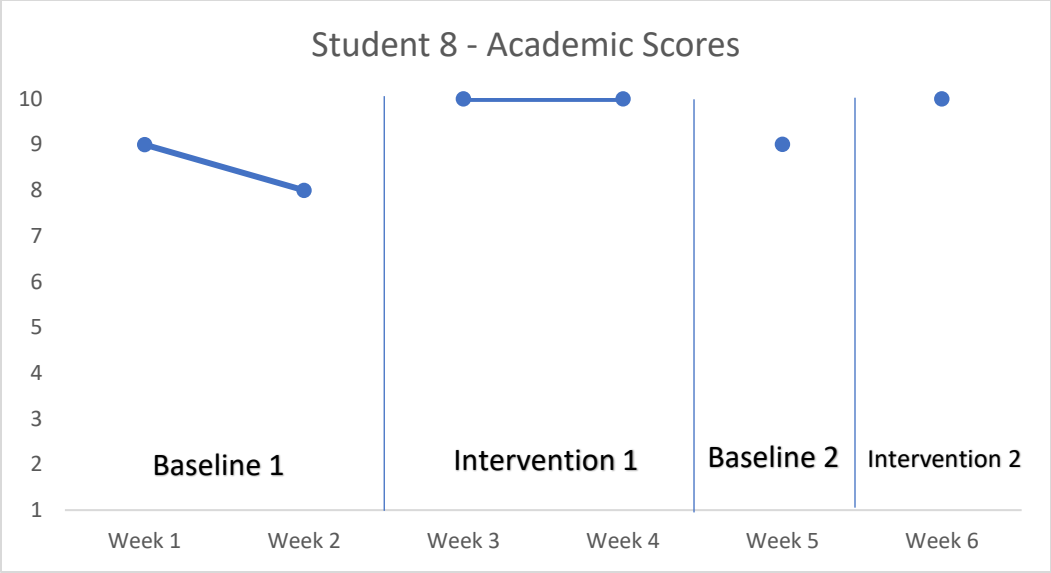

Figure 19. Student 8 Academic Scores

Student 9 is a 15 year old Caucasian male. He was found eligible for services under SLD in basic reading skills and fluency (Dyslexia) and ADHD combined type. Figure 20 shows the engagement scores in points for Student 9. During week 1 of baseline, Student 9's mean engagement score was 3.75, with a high daily score of 7 and low of 2. During week 2 of baseline, the mean score increased to 6.50, with more consistent daily scores. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score increased to 6.75 and then decreased to 6.33 during week 2. During baseline 2, when mini whiteboards were removed, Student 9's mean dropped to 5.50. During intervention 2, when mini whiteboards were reintroduced, the mean rose to 6.30. As seen in Figure 20, Student 9's engagement scores peaked in the first week of

intervention 1, dropped slightly in week 2 of intervention 1, dropped further at baseline 2, and then rose back to the level at intervention 1 during intervention 2.

Figure 21 shows the academic scores in points for Student 9. Student 9's academic score during week 1 of baseline 1 was 2.00 and rose to 5.00 in week 2. During intervention 1, when mini whiteboards were introduced, the academic score rose to 6.00 in week 1 and decreased to 5.00 in week 2. At baseline 2, when mini whiteboards were removed, the score rose to 6.00 and then to 9.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 21, Student 9's academic scores increased over baseline weeks and again slightly when the intervention was introduced. The scores remained nearly the same until they peaked at intervention 2. Student 9's academic scores ranged from as low as 2 points to as high as 9 points.

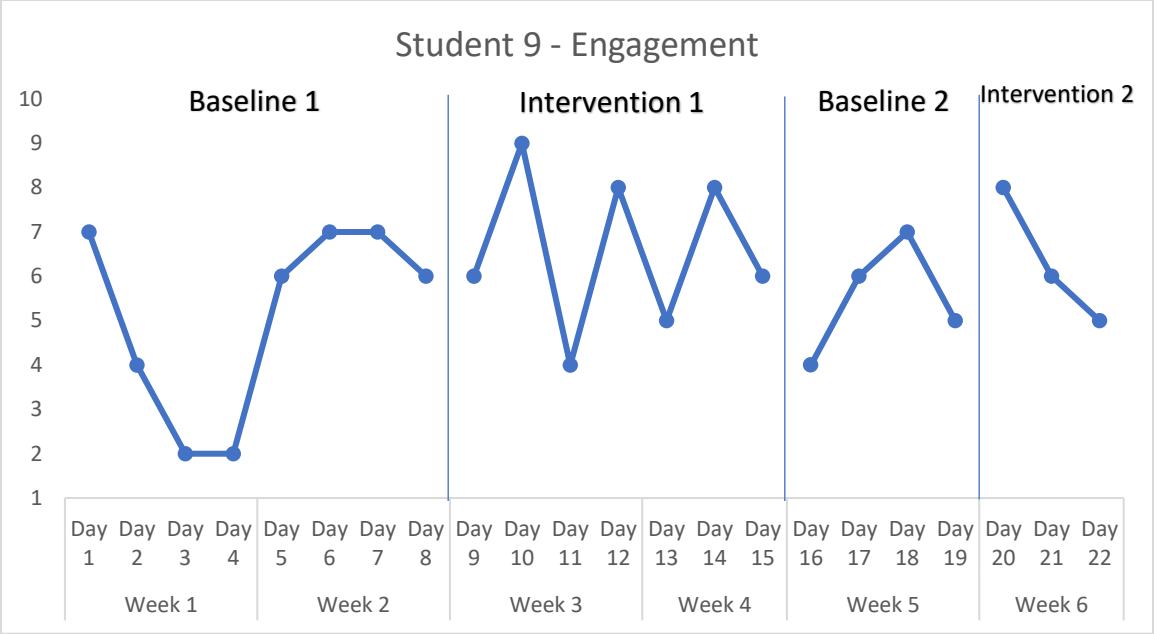

Figure 20. Student 9 Engagement

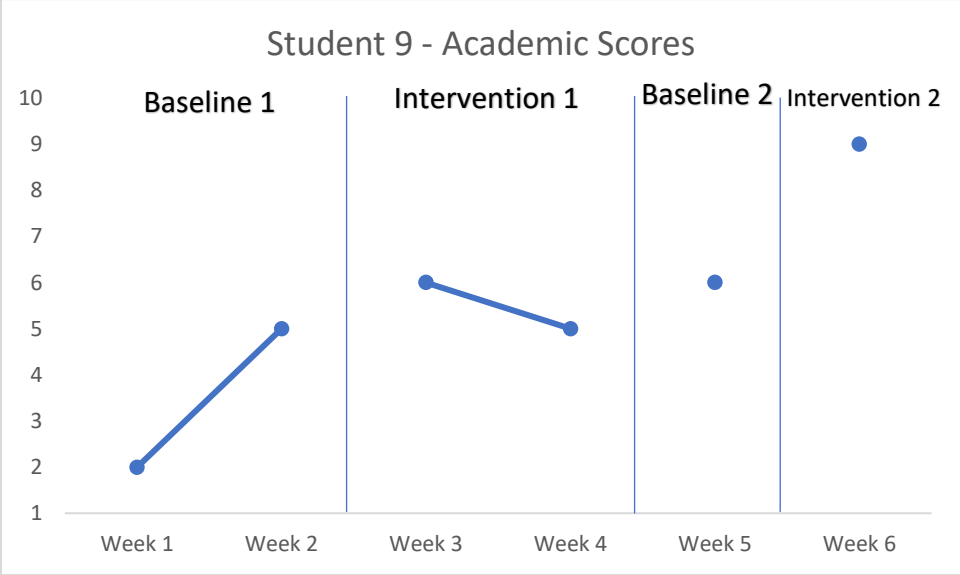

Figure 21. Student 9 Academic Scores

Student 10 is a 15 year old African American male. He was found eligible for services under SLD and has been placed in small group instruction for English and social studies with in-class support for math and science. Figure 22 shows the engagement scores in points for Student 10. During week 1 of baseline, Student 10's mean engagement score was 8.00. During week 2 of baseline, the mean score increased to 8.50, with a high score of 10 achieved on Day 7. During week 1 of intervention 1, when mini whiteboards were implemented, the mean score increased to 8.75, with a high daily score of 10 on Day 10, then decreased to 8.33 during week 2 of intervention 1. During baseline 2, when mini whiteboards were removed, Student 10's mean dropped to 8.00, with another daily score of 10 on Day 19. During intervention 2, when mini whiteboards were reintroduced, the mean remained at 8.00, with all three data points the same. As seen in Figure 22, Student 10's engagement scores remained fairly steady but peaked at the onset of intervention and then returned to baseline for the last two phases.

Figure 23 shows the academic scores in points for Student 10. Student 10's academic score during week 1 of baseline 1 was 8.00 and dropped to 5.00 in week 2. During intervention 1, when mini whiteboards were introduced, the academic score remained at 5.00 in week 1 and rose to 10.00 in week 2. At baseline 2, when mini whiteboards were removed, the score dropped to 7.00 and then rose to 9.00 during intervention 2 when mini whiteboards were reintroduced. As seen in Figure 23, Student 10's academic scores dropped over the baseline weeks and remained the same at the start of intervention. During week 2 of intervention 1, the peak score occurred with a perfect

10. This decreased in baseline 2 but rose again at intervention 2. Student 10's academic scores ranged from as low as 5 points to as high as 10 points.

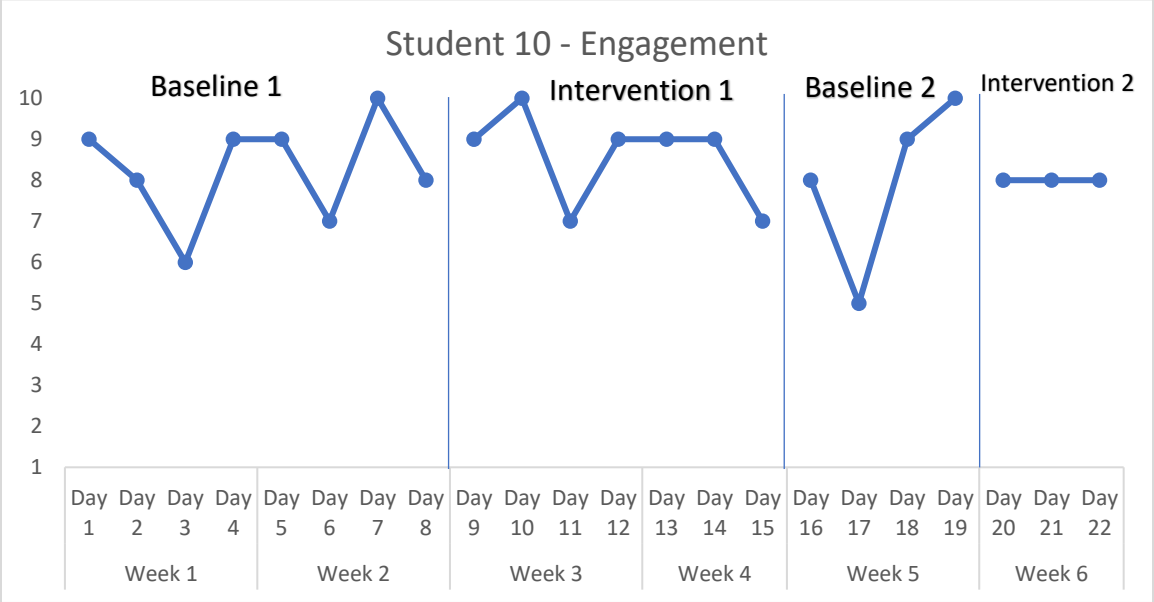

Figure 22. Student 10 Engagement

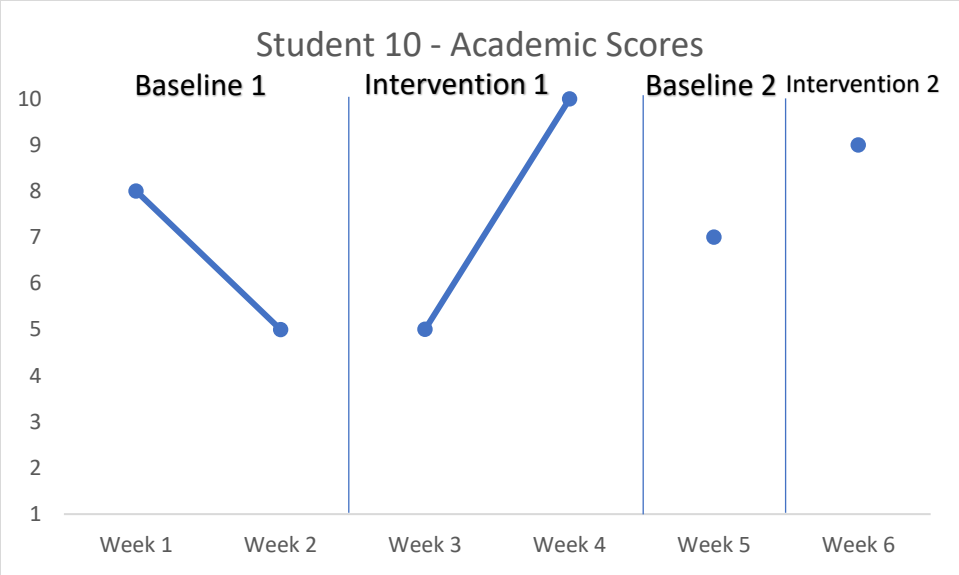

Figure 23. Student 10 Academic Scores

Student Satisfaction

Research question three asked, will students be satisfied with the use of mini whiteboards for assisted instruction in a high school English classroom? Student satisfaction with the use of mini whiteboards was measured at the end of the study using a Likert Scale survey. The survey was completed anonymously by each student. It contained nine statements and required students to select their level of agreement from the following options: strongly agree, agree, neutral, disagree, or strongly disagree. Students were able to share any additional comments on the open ended tenth question. Results were measured, and percentages of student responses are presented in Table 6.

Table 6

Student Satisfaction Survey Results in Percentages

	STRONGLY AGREE %	AGREE %	NEUTRAL %	DISAGREE %	STRONGLY DISAGREE %
1. MINI WHITEBOARDS WERE EASY TO USE.	28.5	28.5	43	0	0
2. MINI WHITEBOARDS WERE DIFFICULT TO USE.	0	0	29	14	57
3. USING MINI WHITEBOARDS HELPED ME TO BETTER UNDERSTAND WHAT I WAS LEARNING IN CLASS.	14	29	43	14	0
4. MINI WHITEBOARDS ALLOWED ME TO EASILY WORK TOGETHER WITH MY CLASSMATES.	0	14	71	14	0
5. I FELT COMFORTABLE SHARING MY ANSWERS ON MINI WHITEBOARDS.	43	14	29	14	0
6. AFTER USING MINI WHITEBOARDS, I PERFORMED BETTER ON MY DAILY ASSIGNMENTS.	0	43	43	14	0
7. AFTER USING MINI WHITEBOARDS, I WAS MORE ENGAGED IN MY LEARNING.	0	43	43	14	0
8. I ENJOYED USING MINI WHITEBOARDS.	0	14	57	29	0
9. I WOULD LIKE TO USE MINI WHITEBOARDS IN THE FUTURE.	0	0	86	14	0

Seven out of ten students took the survey at the end of the study. The other three students declined. According to the results of the student survey, only 14% of the students enjoyed using mini whiteboards, with 57% reporting feeling neutral about mini whiteboard use. Over half of the students (57%) felt that mini whiteboards were easy to use. Nearly half of the students (43%) felt that using mini whiteboards helped them better understand the lesson, while only 14% felt that it helped them work together with classmates. Over half of the students (57%) agreed that they felt comfortable sharing answers on the mini whiteboards. All but one student agreed (43%) or felt neutral (43%)

about the statement that mini whiteboards allowed them to perform better on assignments. No students indicated that they would like to use mini whiteboards in the future, but 86% responded neutrally to this statement. Two students chose to leave additional comments about the use of mini whiteboards in the classroom. One student stated that they "didn't like using them every day, but sometimes it was okay," while the other stated that it "wasn't a pleasant thing to use, so it was and wasn't a good thing for my learning."

Chapter 5

Discussion

The purpose of this study was to examine the effectiveness of mini whiteboards in increasing the engagement and academic achievement of students in a tenth grade English/Language Arts resource center classroom. At the conclusion of the study, students completed a survey to determine if they were satisfied with the use of mini whiteboards.

Findings

The results of this study show that engagement increased during the intervention phases for 7 out of 10 students. When mini whiteboards were introduced into the classroom, engagement increased for Students 5 and 8 across both intervention phases and remained above the scores at initial baseline. Students 9 and 10 also showed increased engagement during the first intervention phase but only slightly above baseline scores. Both returned to baseline levels after initial intervention. Students 1 and 3 showed increased engagement that was less consistent. Both had peak scores during baseline phases, but Student 1 had erratic scores that stabilized close to the highest score during intervention phases, and Student 3 had varying scores but remained above initial baseline at intervention 2. Both students were also absent for several days of the study, which could account for some of the inconsistency. Student 2 had a peak score during week 2 of intervention 1 but returned to baseline scores over the remainder of the period.

The remaining students, Students 4, 6, and 7 had scores that were fairly consistent across all phases and did not appear to be positively influenced by the intervention. Student 4 experienced a significant change in mood and behavior during the intervention and, at times, refused to use the whiteboards during class. This could account for his consistently low scores that did not improve with the addition of mini whiteboards. Student 6's lack of improvement during intervention could be caused by his diagnosis of ADHD and lack of ability to monitor his own behavior. His use of the whiteboards was inconsistent and often off task. Finally, Student 7 maintained moderately high scores across all phases with little variance, suggesting that his tendency to remain on task during class was independent of the use of whiteboards.

The finding that mini whiteboards increased student engagement for 7 out of 10 students coincides with the findings of Nagro et al. (2016) and Clayton and Woodard (2007), suggesting the use of whole class responding is effective for increasing student engagement and participation over SSR. More specifically, this research supports the findings of Christle and Schuster (2003), Lambert at al. (2006), and Musti-Rao et al. (2008), suggesting that the use of mini whiteboards is an effective strategy for improving student engagement and participation.

The results of this study also show that the weekly academic achievement scores increased during intervention phases for 8 out of 10 students. When mini whiteboards were introduced, academic performance increased for Students 8 and 10 during both intervention phases. Student 10 had peak scores in week 2 of the first intervention phase and the final intervention, while Student 8 achieved perfect scores during each week

when the intervention had been implemented. Students 5 and 7 both achieved peak scores during the first intervention and then returned to baseline levels in the second. Students 3, 4, 6, and 9 all had peak academic scores in the final intervention phase. Student 3 had mostly consistent high scores with a slight dip at the start of intervention 1 and then reached a perfect 10 at intervention 2. Student 4 had fairly high scores at baseline that dropped significantly in intervention 1, returned to baseline in baseline 2, and then peaked with a high score in intervention 2. As previously described, this student experienced an emotional setback that may account for the steep drop in his scores, as he refused to participate fully in the lessons during the first intervention. Students 6 and 9 had a significant variance in their scores over most of the study which then peaked in the final intervention. Neither student took the intervention seriously on a daily basis, and one student engaged in frequent distracting behaviors, while the other used his cell phone frequently during class. These behaviors could account for the inconsistent improvement of their scores though they did achieve their highest in the final intervention.

The remaining students, Students 1 and 2, did not rise above initial baseline scores at any point in the intervention phases, suggesting that the use of mini whiteboards was not an effective strategy for increasing their academic performance. Student 2 has fairly consistent scores across the study period that dropped slightly in week 2 of intervention 1, went up slightly at return to baseline, and returned to baseline level at intervention 2. Similarly, Student 1 had somewhat consistent scores that dropped significantly at intervention 1 and then gradually increased, returning to the highest baseline level again at intervention 2.

The finding that mini whiteboards increased academic performance for 8 out of 10 students coincides with the findings of Randolph (2007), who performed a meta-analysis on the evidence of academic improvement from the use of RC over SSR. More specifically, this research coincides with studies done by Christle and Schuster (2003), Gardner et al. (1994), Maheady et al. (2002), and Cavenaugh et al. (1996) who all found a positive association between the use of mini whiteboards for whole class response and academic performance of students at varying academic levels. Though this study found the same positive association for many students, academic improvement did not occur for all students and was inconsistent for some students. This discovery correlates with the research done by Musti-Rao et al. (2008), who found mixed results in terms of the level of impact RC had on improving quiz grades. Though some students showed inconsistent academic improvement, nearly all students who participated in the study had higher quiz scores under at least one of the intervention conditions.

Limitations

This study had several possible limitations. One limitation may have been the time frame of the study. The study was conducted over a six week period from February 2019 to April 2019. Due to a rotating letter day (SMART) schedule used by the school, classes would only meet for 3-4 days per calendar week and would be dropped from the schedule every 3 days. This limited the amount of class periods that could be observed across the six week period. Due to this schedule a week was defined as a 3-4 class period block and did not coincide with calendar weeks. This ensured that each class was observed for the same amount of time and for the same lessons. However, this

arrangement was not ideal as it caused weekly quizzes to sometimes occur on a Monday or when the class had not met the previous school day. Two days during this time period were not utilized in the study due to altered schedules, such as for a pep rally day at the end of spirit week. The data from the study may have been stronger if classes had met for five consecutive days each week. In addition, there was a 3-day period within the study time frame where data was not collected and intervention was not used due to the teacher's absence for a previously scheduled trip. The data may have been stronger without such a disruption in the schedule of the study.

A second limitation may have been the number of participants in the study. Only ten tenth grade students, five from each of the two classes, participated in this study. Due to this small population, the results of this study may not be generalized to all of the tenth grade students in special education. More specifically, the results of this study may be limited for two students who had inconsistent attendance. Student 1 was absent from school for two days of the study during baseline assessment, which resulted in incomplete data. Student 3 was absent from school for two of the days and missed two other lessons due to being at the nurse or guidance. Three of the four missed classes occurred consecutively at the start of intervention, causing her to miss almost the entire first week of intervention. This caused her to essentially begin the intervention a week after her classmates and to have less time to benefit from it.

A third limitation may have been the content of the lessons during the time of the study. As this study occurred in an English/Language Arts classroom, students were required to read and discuss a piece of literature. The study occurred during a unit on

Shakespeare's *The Tragedy of Julius Caesar*. While this would be a difficult text for any student, students in the resource setting were especially concerned about reading and analyzing such a high level text. Their difficulty with the content, and the requirement of closely analyzing the text, may have contributed not only to lower quiz scores but also toward instances of off-task behavior as a result of their frustration with or disinterest in the text.

Implications and Recommendations

Though this study had some limitations, the data suggests that the use of mini whiteboards may help to increase the engagement and academic achievement of students in a tenth grade resource center English classroom. Mini whiteboards were found to increase the weekly mean engagement score for 7 out of 10 students and the weekly academic achievement score for 8 out of 10 students. Students 3, 5, 8, 9, and 10 increased in both engagement and academic achievement. This coincides with prior research that has suggested that the use of RC is an effective strategy for increasing student engagement (Nagro et al., 2016; Clayton & Woodard, 2007; Musti-Rao et al., 2008; Lambert et al., 2006; and Adamson & Lewis, 2017), research that has suggested that the use of RC improves academic performance (Cavanaugh et al., 1996), as well as research that has found both positive correlations between RC use and improved engagement and academic performance (Christle & Schuster, 2003; Gardner et al., 1994; Maheady et al., 2002; and Randolph, 2007). As a result of most students only increasing their weekly engagement and academic scores during one of the intervention phases, the findings may

be considered inconsistent. However, nearly all students in both classes achieved engagement and academic scores that were equal to or greater than their baseline scores.

Larger implications for educating students in a resource center English classroom emerging from this study include the recommendation to incorporate additional educational strategies such as mini whiteboards in the classroom. Mini whiteboards may be an effective SRS in the classroom for allowing increased student engagement through whole class responding and higher response rates, opportunities for constructive added weight time for students to formulate responses, and immediate teacher feedback. Considering the results of the satisfaction survey, some students may not prefer the use of mini whiteboards to a more passive role in the classroom; however, several students were aware of it having a positive impact on their learning. In connection with prior research, it is recommended that educational strategies that increase student response rates are continually implemented in the classroom to improve student learning (Malanga & Sweeney, 2008). Additionally, further research is recommended in order to strengthen the connection between student response strategies and student engagement and academic achievement.

Conclusions

This study was successful in that it increased the engagement and academic performance of students in a tenth grade resource center English classroom. The study also confirmed that some students were satisfied with the use of mini whiteboards. While this study attempted to determine the effectiveness of mini whiteboards in increasing active engagement and academic achievement of students, results were not consistent

across all phases of the study or across all students. Recommendations for future research include conducting similar studies with larger populations of students as well as implementing and assessing such strategies and their impact with a more consistent schedule of class meetings and investigating whether more prolonged use of mini whiteboards impacts student outcomes.

References

Adamson, R. M., & Lewis, T. J. (2017). A comparison of three opportunity-to-respond strategies on the academic engaged time among high school students who present challenging behavior. *Behavior Disorders, 42*(2), 41-51.

Anthis, K. (2011). Is it the clicker or the question? Untangling the effects of student response system use. *Teaching of Psychology, 38*(3), 189-193.

Brady, M.; Seli, H.; & Rosenthal, J. (2013). "Clickers" and metacognition: A quasi-experimental comparative study about metacognitive self-regulation and use of electronic feedback devices. *Computers & Education, 65*(1), 56-63.

Cavanaugh, R. A.; Heward, W. L.; & Donelson, F. (1996). Effects of response cards during lesson closure on the academic performance of secondary students in an earth science course. *Journal of Applied Behavior Analysis, 29*(3), 403-406.

Christle, C. A., & Schuster, J. W. (2003). The effects of using response cards on student participation, academic achievement, and on-task behavior during whole-class, math instruction. *Journal of Behavioral Education, 12*(3), 147-165.

Clayton, M. C., & Woodard, C. (2007). The effect of response cards on participation and weekly quiz scores of university students enrolled in introductory psychology courses. *Journal of Behavioral Education, 16*(1), 250-258.

Dallaire, D. H. (2011). Effective use of personal response "clicker" systems in psychology courses. *Teaching of Psychology, 38*(3), 199-204.

Danielson, M. L.; Bitsko, R. H.; Ghandour, R. M.; Holbrook, J. R.; Kogan, M. D.; & Blumberg, S. J. (2018). Associated treatment among U.S. children and adolescents, 2016. *Journal of Clinical Child and Adolescent Psychology, 47*(2), 199-212.

Fallon, M., & Forrest, S. L. (2011). High-tech versus low-tech instructional strategies: A comparison of clickers and handheld response cards. *Teaching of Psychology, 38*(3), 194-198.

Fies, C., & Marshall, J. (2006). Classroom response systems: A review of the literature. *Journal of Science Education and Technology, 15*(1), 101-109.

Gardner III, R.; Heward, W. L.; & Gross, T. A. (1994). Effects of response cards on student participation and academic achievement: a systematic replication with inner-city students during whole-class science instruction. *Journal of Applied Behavior Analysis, 27*(1), 63-71.

Glass, C. S. (2000). Factors influencing teaching strategies used with children who display attention deficit hyperactivity disorder characteristics. *Education, 122*(1), 70-79.

Green, A. (2016). Significant returns in engagement and performance with a free teaching app. *The Journal of Economic Education, 47*(1), 1-10.

Hamilton, N. J., & Astramovich, R. L. (2016). Teaching strategies for students with ADHD: Findings from the field. *Education, 136*(4), 451-460.

Heaslip, G.; Donovan, P.; & Cullen, J. G. (2013). Student response systems and learner engagement in large classes. *Active Learning in Higher Education, 15*(1), 11-24.

Hunsu, N. J.; Adesope, O.; & Bayly, D. J. (2015). A meta-analysis of the effects of audience response systems (clicker-based technologies) on cognition and affect. *Computers & Education, 94*(1), 102-119.

Kay, R. H., & LeSage, A. (2009). Examining the benefits and challenges of using audience response systems: A review of the literature. *Computers & Education, 53*(1), 819-827.

Kulezsa, A. E.; Clawson, M. E.; & Ridgway, J. S. (2014). Student success indicators associated with clicker-administeredq in an honors introductory biology course. *Research and Teaching, 43*(4), 73-79.

Lambert, M. C.; Cartledge, G.; Heward, W. L.; & Lo, Y. (2006). Effects of response cards on disruptive behavior and academic responding during math lessons by fourth-grade urban students. *Journal of Positive Behavior Interventions, 8*(2), 88-99.

Lasry, N. (2008). Clickers or flashcards: Is there really a difference? *The Physics Teacher, 46*(1), 242-244.

Maheady, L.; Michielli-Pendl, J.; Mallette, B.; & Harper, G. F. (2002). A collaborative research project to improve the academic performance of a diverse sixth grade science class. *Teacher Education and Special Education, 25*(1), 55-70.

Malanga, P. R., & Sweeney, W. J. (2008). Increasing active student responding in a university applied behavior analysis course: The effect of daily assessment and response cards on end of week quiz scores. *Journal of Behavioral Education, 17*(1), 187-199.

Musti-Rao, S., Kroeger, S. D., & Schumacher-Dyke, K. (2008). Using guidedn and responsec at the postsecondary level. *Teacher Education and Special Education, 31*(3), 149-163.

Nagro, S. A.; Hooks, S. D.; Fraser, D. W.; & Cornelius, K. E. (2016). Whole-group response strategies to promote student engagement in inclusive classrooms. *Teaching Exceptional Children, 48*(5), 243-249.

Penuel, W. R.; Boscardin, C. K.; Masyn, K.; & Crawford, V. M. (2007). Teaching with student response systems in elementary and secondary education settings: A survey study. *Educational Technology Research and Development, 55*(4), 315-346.

Preszler, R. W.; Dawe, A.; Shuster, C. B.; & Shuster, M. (2006). Assessment of the effects of student response systems on student learning and attitudes over a broad range of biology courses. *Life Sciences Education, 6*(1), 29-41.

Randolph, J. J. (2007). Meta-analysis of the research on response cards: Effects on test achievement, quiz achievement, participation, and off-task behavior. *Journal of Positive Behavior Interventions, 9*(2), 113-127.

Stowell, J. R., & Nelson, J. M. (2007). Benefits of electronic audience response systems on student participation, learning, and emotion. *Teaching of Psychology, 34*(4), 253-258.

Tlhoaele, M.; Hofman, A.; Naidoo, A.; & Winnips, K. (2014). Using clickers to facilitate interactive engagement activities in a lecture room for improved performance by students. *Innovations in Education and Teaching International, 51*(5), 497-509.

Trees, A. R., & Jackson, M. H. (2007). The learning environment in clicker classrooms: student processes of learning and involvement in large university-level courses using student response systems. *Learning, Media and Technology, 32*(1), 21-40.

Wood, K. D., & Beattie, J. (2004). Meeting the literacy needs of students with ADHD in the middle school classroom. *Middle School Journal, 35*(3), 50-55. doi:10.1080/00940771.2004.11461432