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Extending Research on Self-Monitoring Interventions using Assistive Technology for Students with Disabilities

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I am submitting herewith a dissertation written by Laura Ann Mahany entitled "Extending Research on Self-Monitoring Interventions using Assistive Technology for Students with Disabilities." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

David Cihak, Major Professor

We have read this dissertation and recommend its acceptance:

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Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)
Extending Research on Self-Monitoring Interventions using Assistive Technology for Students with Disabilities

A Dissertation Presented for the
Doctor of Philosophy Degree
The University of Tennessee, Knoxville

Laura Ann Mahany
December 2018
Dedication

To my parents,

Gary and Patricia Mahany,

who taught me dreams can be limitless,

who demonstrated love and support, always unconditional,

and who taught me the right balance of stubbornness and persistence may push me further than I

have ever imagined.

Thank you.
Acknowledgement

The journey of a doctoral program is filled with immense support from all angles, none of which will ever be forgotten. I am grateful for each warm embrace, sturdy kick, lent ear, soft shoulder, and fresh set of eyes to help guide me to where I am going and keep me from straying far from my objectives. I would not be here without the support of so many people.

My parents, Gary and Patricia Mahany, have been my number one supporter, despite any antics and unconventional paths I may follow. Without them and the solid foundation they instill, I simply would not be who I am today. The advice, love, and silent frustration they provide for me has been a cornerstone for any and all of my success. I love you so much.

To Elijah Ellerbush, this work would not have been possible without your love, understanding, and support. Thank you is not enough. Your kindness, intelligence, and fresh perspective on ideas has been crucial to keeping any success rolling. Thank you for being my rock, my confidant, and my drive.

Thank you to the support of Amber Wright, Heather Feenaughty, Rachel Fuqua, and Stelli Regan for the friendship, advice, and laughs necessary to come out of this journey stronger and more invigorated. A sweet friendship refreshes the soul.

Thank you to Dr. Karen Loy, whose high expectations and consistent support over the years has helped keep me grounded in whatever adventure I try to tackle. Her love for special education helped continue to fuel my own ideas and fill the gaps where needed, without it I would not be where I am today.

Finally, a sincere thank you to my committee of Dr. David Cihak, Dr. Tara Moore, Dr. Mari Beth Coleman, and Dr. Chris Skinner. The unwavering support and guidance over the years has truly helped me continue down this path with confidence and awe at what each of you brings to the table. My incredible committee has helped shape my understanding of what I know, and appreciate how much I still have to learn. Thank you all for your feedback, understanding, and expertise on this topic.

“Your happiness is at the intersection of your passions and learning from great people.”

-Scott Weiss
Abstract

Technology is increasingly present in our classrooms, with expectations that students will each have their own device in a 1:1 classroom in every school. With classroom management as the most important factor affecting student learning and achievement (Emmer & Stough, 2001; Wang, Haertel, & Walberg, 1993), the purpose of this two-companion studies dissertation is to research the use of technology and self-management system components to determine its effects on on-task engagement and disruptive classroom behavior of adolescents with disabilities.

The first chapter is a literature review providing an overview of self-management, focusing on self-monitoring and self-graphing. The literature review synthesizes the research regarding specific components related to student task engagement and behavior within the classroom and describes how technology has been utilized in current literature.

In Study I, four adolescent students were successfully taught to use Google Forms© to self-record their behavior. Data were collected to compare a paper-based self-recording procedure or a technology-based procedure using a single-case alternating treatments design. Results indicated that students using technology was more efficient and increased on-task performance and/or decreased disruptive behavior better or equal to paper-based self-monitoring procedures. Additionally, both students and teachers preferred technology to paper-based self-monitoring.

During Study II, the same four students participated in a second alternating treatments design study to compare paper-based self-graphing procedures or automatic graphing procedures on Google Forms©. Results indicated that students using technology-based automatic graphing increased on-task performance and/or decreased disruptive behavior better or equal to paper-based self-graphing. Moreover, technology-based automatic graphing was more efficient. Also,
both students and teachers preferred technology to paper-based self-monitoring.

Chapter 4 discusses these findings, conclusions, implications, and how utilizing technology has impacted self-monitoring in the context of using a more efficient intervention given similar efficacious results. Limitations and recommendations for future research in self-monitoring with technology for students with disabilities are provided.
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Chapter I:

Understanding Self-Monitoring Interventions with the use of Technology for Students with Function-Based Behavior
Teachers spend a considerable amount of time managing student behavioral issues. High frequency, low-intensity, disruptive, and off-task behavior are considered especially problematic because they result in loss of instructional time and negatively impact the learning process (Aloe, Amo, & Shanahan, 2014; Sullivan, Johnson, Owens, & Conway, 2014). Wang, Haertel, and Walberg (1993) suggested that classroom management is the most important factor affecting student achievement and learning. However, teachers often use reactive strategies to manage only disruptive behavioral outcomes, a choice that correlates with decreased levels of students’ task engagement (Clunies-Ross, Little, & Kienhuis, 2008).

Self-management is defined as the personal application of behavior change actions or techniques to bring about a desired change to one’s own behavior (Cooper, Heron, & Heward, 2007; Shapiro & Cole, 1994). Students systematically learn to self-record the occurrence of a target behavior as the basis of self-management interventions (Cooper et al., 2007). According to the literature, self-management interventions vary in terms of degree of student involvement and composition (Briesch & Chafouleas, 2009; Hoff & Sawka-Miller, 2010). However, intentionally and systematically shifting responsibility from the teacher to the student can encourage self-reliance (Shapiro & Cole, 1999), which can aid students in multiple aspects of their lives.

Purpose and Organization

This dissertation, composed of four chapters, evaluates two-companion studies to examine the effectiveness and efficiency of utilizing technological-based self-monitoring and evaluation components of self-management on task-engagement and disruptive behavior among adolescent students in the classroom setting. Chapter 1 reviews current research, definitions, and theoretical foundations on how technology has been utilized in self-management components. Chapter 2 describes the first study of this two-study dissertation, which was conducted and
evaluated independently of the second intervention. Chapter 2 describes study one that examines the differential effects of self-monitoring using technology versus pencil and paper-based procedures, as well as the amount of time to self-monitor on task-engagement and disruptive behavior. Chapter 3 describes the second study of this two-study dissertation and was conducted and evaluated independently of the first intervention. This study examines the differential effects of self-graphing using automatic self-graphing technology and pencil and paper-based procedures, as well as the amount of time to self-graph on task-engagement and disruptive behavior within the classroom. Chapter 4 discusses the findings and implications from both studies, and particularly considers the contexts of self-monitoring, self-evaluation, and time required to self-monitor or self-graph.

**Research Questions**

**Study I.** The purpose of this study was to compare the effects of a paper-based self-recording procedure or a technology-based self-recording procedure on task engagement and disruptive behavior in a classroom setting for middle school-aged students with disabilities who have a history of demonstrating behaviors that interfere with their learning and/or the learning of others. Specific research questions include:

1. What were the effects of using a paper-based self-recording procedure for middle school students with disabilities on task-engagement and disruptive behavior?
2. What were the effects of using a technology-based self-recording procedure for middle school students with disabilities on task-engagement and disruptive behavior?
3. What were the differential effects of using a paper-based and a technology-based self-recording procedure?
4. What do students think about using paper-based and a technology-based self-recording
procedure?

**Study II.** The purpose of this study was to compare the effects of using a paper-based self-graphing procedure or a technology-based self-graphing procedure to address task engagement and disruptive behavior in the classroom setting. Specific research questions include:

1. What were the effects of using a paper-based self-graphing procedure for middle school students with disabilities on task-engagement and disruptive behavior?
2. What were the effects of using a technology-based self-graphing procedure for middle school students with disabilities on task-engagement and disruptive behavior?
3. What were the differential effects of using paper-based and technology-based self-graphing procedures?
4. What do students think about using paper-based and technology-based self-graphing procedures?

**Self-Determination Theory**

Self-management interventions are supported by the self-determination theory (Deci & Ryan, 1985). Self-determination theory includes three innate needs that allow for optimal function and growth: autonomy, relatedness, and competence, (DeCharms, 1968; Deci, 1975; Deci, Ryan, & Williams, 1996; Harter, 1978; White, 1963). Autonomy is the need to be a causal agent of one’s own life, yet does not mean to be independent of others (Vansteenkiste, Lens, & Deci, 2006). Wehmeyer and Schwartz (1997) reported that self-determined students were more likely to achieve higher post-school outcomes compared to peers who lack self-determined skills. An individual’s sense of autonomy represents a “choicefullness” and the feeling of full volition regarding one’s activities and goals in which people are often moved by external factors such as
reward systems, grades, evaluations, or opinions of others (Deci & Ryan, 1985). Relatedness is the need to be connected to, interact with, and experience care for others (Deci & Ryan, 2002). Competence refers to seeking to control the outcome and experience mastery (White, 1959). Giving students unexpected positive feedback on a task fulfills people’s need for competence, thereby increasing students’ intrinsic motivation to complete the task (Deci, 1975). Deci and Ryan (2000) suggested that competence, relatedness, and autonomy are essential for ongoing psychological growth, integrity, and well-being.

**Self-Monitoring Components**

Within self-management are specific components, which allow for students to monitor their own progress or evaluate their own behavior. Kanfer (1971) suggested three primary components: self-monitoring, self-evaluation, and self-reinforcement. However, these components are defined broadly, and researchers have focuses on different aspects of the self-managing process throughout the research literature (Carter et al., 2011; Hayes & Nelson, 1977; Mace, Belfiore, & Hutchinson, 2001). Hayes and Nelson (1977) added to Kanfer (1971) initial components to include: goal setting, training on the device, obtaining the device that will be used for self-monitoring, and reactivity. Rachlin (1974) suggested that self-monitoring works because the environment provides cues for the student to react with appropriate behavior, and any of the components of self-monitoring are able to contribute to behavior change, according to Nelson and Hayes (1981).

Self-management interventions have been identified as a high-leverage practice (HLP) used effectively to address social, communication, behavior, school-readiness, play, vocational, and academic outcomes (McLeskey et al., 2017; Neitzel & Busick, 2009). Self-management interventions, which can include self-monitoring, self-reflection, and adapting to a given context,
are self-regulation strategies students can use to learn the routines and norms needed to act appropriately in the classroom, as well as an array of additional social skills and behavior. Self-management allows learners to: (a) discriminate between appropriate and inappropriate behavior, (b) accurately monitor and record their own behavior, and (c) reinforce themselves for appropriate behavior or use of skills. Self-management interventions have been implemented in classrooms to benefit student success (Briesch & Daniels, 2013; Hoff & Sawka-Miller, 2010; Maag, 1999; Moore et al., 2013; Rafferty, 2010).

Self-monitoring behavior for students in the classroom have been widely used as a behavior management and academic strategy to teach students to become more aware of their actions through recording and tracking their behavior (Mace, Belfiore, & Hutchinson, 2001). The idea is that when undesirable behaviors are targeted, they will decrease (Broden, Hall, & Mitts, 1971). This works particularly well when only a few specific behaviors are targeted to occasion a greater probability of behavior change (Mace & Kratochwill, 1985). Self-monitoring has been well-researched and found to be successful with students across ability levels (Briesch & Chafouleas, 2009; Graham-Day, Gardner, & Hsin, 2010; Sheffield & Waller, 2010), and may result in generalization across time and settings (Holman & Baer, 1979). Self-monitoring has been shown to be effective with children with autism (Koegel et al., 1992), emotional-behavioral disabilities (Grossi & Heward, 1998), and attention-deficit disorder (Harris, 1986). Also, self-management has been linked to improved academic success (Harris, 1986; Harris et al., 1994; Lee & Tindal, 1994; Wolfe, Heron, & Goddard, 2000) and task engagement behaviors (Graham-Day, Gardner, & Hsin, 2010).
Self-Monitoring in Literature

A review of literature was conducted to identify self-monitoring research related to on-task, off-task, or disruptive behaviors in the classroom for students identified with disabilities or at-risk behaviors. Articles were identified through the ERIC database, Ebsco host, and PsychINFO. Key search terms included behavioral disorders, emotional disturbance, conduct disorder, at-risk behavior, ADHD or ADD, in combination with self-management, self-monitoring, self-evaluation, self-recording, on-task, and off-task. Published articles including students with at-risk behaviors in the classroom were targeted, which included students with attention-deficit disorder, emotional disturbance, other health impairments, and students not identified for a disability but who exhibited at-risk behaviors. Articles that addressed students in grades 1st through 12th, and occurred in general education, special education, or residential treatment facilities were included. Only articles published between 1990 and 2018 were included in this study.

To be considered in the review, independent variables needed to include self-monitoring interventions and dependent variables needed to include on-task or off-task behaviors that were observable and measurable. Disruptive behavior not paired with on-task behavior were excluded as a dependent variable in this literature review. Interventions that only included self-monitoring academics, self-monitoring skills that were not observable, or pharmaceutical interventions paired with self-monitoring were not considered for this literature review. Other literature reviews or meta-analysis were not included, but articles referenced in those literature reviews were reviewed to determine qualifications within this literature review. Articles were included if they were peer reviewed and included student-led self-monitoring. A total of 24 studies met the criteria and qualified for this review.
Sixty-three students were identified within the 24 studies, ranging in ages and disabilities. Articles in this review targeted students with disabilities including learning disability ($n = 7$), attention deficit-hyperactivity disorder or attention deficit disorder ($n = 19$), emotional and behavioral disorders ($n = 22$), at-risk ($n = 12$), and identified as high-incidence ($n = 3$). Within these studies, $23.8\%$ of students were female ($n = 15$), $68.3\%$ were male ($n = 43$), and $7.9\%$ were not identified ($n = 5$). Almost half ($46.9\%$) of the identified students were Caucasian ($n = 29$), $15.8\%$ were African American ($n = 10$), $4.7\%$ were Hispanic ($n = 3$), $3.2\%$ was Native American ($n = 2$), and $30.2\%$ of student ethnicities were not identified within the research ($n = 19$). Ages ranged from 8 years old to 16 years old, often identifying students based on grade level instead of current age.

The 24 identified studies were categorized in the following themes: self-monitoring intervention components, self-monitoring interventions using multiple components (Table 1), self-monitoring interventions using ancillary supports (Table 2), and self-monitoring interventions incorporating the use of technology (Table 3).

**Self-Monitoring Intervention Components**

**Goal setting.** Goal setting is a mutually agreed-upon decision between the student and teacher to monitor specific target behaviors, and to devise a plan to achieve the desired result. Students who set their own goals have been found to perform better than students whose goals were set for them (Johnson, Graham, & Harris, 1997; Olympia et al., 1994). However, little research has been conducted regarding the effects of student selected goals. No studies in this review included goal setting. This review updates Diagangi, Maag, and Rutherford (1991) previous review of literature that indicated only $5\%$ of studies included students who self-selected goals. Most self-management studies included goals determined by the teacher or
### Table 1

*Summary of Studies using Multiple Self-Monitoring Components*

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Design</th>
<th>IV</th>
<th>DV</th>
<th>Students</th>
<th>Diagnosis</th>
<th>Setting</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digangi, Maag, and Rutherford (1991)</td>
<td>Self-Graphing of On-Task Behavior: Enhancing the Reactive Effects of Self-Monitoring</td>
<td>multiple treatment 6</td>
<td>SG, SE, SR, SM random intervals 30 to 90 seconds</td>
<td>on-task behavior, academics</td>
<td>2 females, age 10 &amp; 11</td>
<td>SLD math</td>
<td>resource room</td>
<td>47/55% baseline to 55/74% SM to 77/71% SM and SG to 77/70% SM, SG, SR to 81/88% SM, SG, SR, SE.</td>
</tr>
<tr>
<td>Digangi and Maag (1992)</td>
<td>A Component Analysis of Self-Management Training</td>
<td>A-B-BC-C-D-DB-DBC-DC</td>
<td>verbal behavior</td>
<td>3 students: 2 males, 12-13 years, 1 female, 13 years</td>
<td>EBD</td>
<td>resource room, math</td>
<td>SM, SE/SR were least effective individually. SI most effective in isolation. Combinations were most effective across all 3 subjects</td>
<td></td>
</tr>
<tr>
<td>Todd, Horner, and Sugai (1999).</td>
<td>Self-Monitoring and Self-Recruited Praise</td>
<td>ABAB withdrawal coupled with multiple baseline</td>
<td>SM, 10 min behavior, academic engagement, work completion</td>
<td>9-year-old 4th grader, male</td>
<td>LD</td>
<td>blended</td>
<td>decrease in problem behavior, increase on-task behavior, increase task completion, increase in teacher praise, increase in overall perception of student performance</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2

**Summary of Studies using Ancillary Supports**

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Design</th>
<th>IV</th>
<th>DV</th>
<th>Students</th>
<th>Diagnosis</th>
<th>Setting</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis et al.</td>
<td>A Comparison of Self-Monitoring With and Without Reinforcement to Improve On-Task Classroom Behavior</td>
<td>Multiple baseline across setting</td>
<td>SM, SM+ token economy</td>
<td>on-task</td>
<td>1 male</td>
<td>none</td>
<td>general education classrooms</td>
<td>62% baseline to 69% SM to 91% SM + reinforcement</td>
</tr>
<tr>
<td>Davies and Witte</td>
<td>Self-management and peer monitoring within group contingency to decrease uncontrolled verbalization of children with ADHD</td>
<td>ABAB</td>
<td>SM with group contingency and Peer Modeling, daily</td>
<td>Verbalization in class</td>
<td>4 students: 2 male, 2 female, 3rd grade, Caucasian case matched with nondisabled peers</td>
<td>ADHD</td>
<td>Classroom</td>
<td>0-15 occurrences baseline, 0-3 occurrences with intervention</td>
</tr>
<tr>
<td>Germer et al.</td>
<td>Function based intervention to increase a second grade student on-task behavior in a general education classroom</td>
<td>ABAB withdrawal</td>
<td>SM, rewards and praise 5 min</td>
<td>On-task behavior</td>
<td>1 male, black, 7 years old</td>
<td>at risk</td>
<td>general education classroom</td>
<td>34.79% baseline to 80.75% intervention</td>
</tr>
</tbody>
</table>

Table 2 continued

*Summary of Studies using Ancillary Supports*

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Design</th>
<th>IV</th>
<th>DV</th>
<th>Students</th>
<th>Diagnosis</th>
<th>Setting</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graham-Day, Gardner, and Hsin (2010)</td>
<td>Increasing On-Task Behaviors of High School Students with ADHD Is it Enough?</td>
<td>alternating treatment</td>
<td>SM, SM with group contingency reinforce</td>
<td>on-task behavior, academic achievement student/ teacher satisfaction</td>
<td>3 10th grade students, Caucasian, 16 years old</td>
<td>ADHD</td>
<td>high school study hall for students with disabilities</td>
<td>51% baseline to 92%, SM to 93% SM and Reinforcer. 46% baseline to 75% SM to 97% SM with reinforcer. 47% baseline to 64% SM to 96% SM with reinforcer.</td>
</tr>
<tr>
<td>Gumpel and Golan (2000)</td>
<td>Teaching Game-Playing social skills using a self-monitoring treatment package</td>
<td>ABAC</td>
<td>SM and group contingency</td>
<td>Positive interactions, social skills</td>
<td>2 boys, 3 girls; 8-10 yrs old</td>
<td>EBD</td>
<td>General education classroom</td>
<td>Weak effect</td>
</tr>
</tbody>
</table>

### Table 3

**Summary of Studies using Technology**

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Design</th>
<th>IV</th>
<th>DV</th>
<th>Students</th>
<th>Diagnosis</th>
<th>Setting</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedesem, (2012)</td>
<td>Using Cell Phone Technology for Self-Monitoring Procedures in Inclusive Settings</td>
<td>multiple baseline</td>
<td>&quot;CellF&quot; Monitoring 1-minute intervals</td>
<td>On-task</td>
<td>2 7th grade students</td>
<td>High Incidence Disability</td>
<td>inclusion</td>
<td>1) 28-64% on-task; 20 53-85% on-task</td>
</tr>
<tr>
<td>Blood et al., (2011)</td>
<td>Using an iPod Touch to Teach Social and Self-Management Skills to an Elementary Student with EBD</td>
<td>A-B-BC</td>
<td>video modeling and self-monitoring, 15 second intervals</td>
<td>On-task, disruptive behavior</td>
<td>10-year-old boy, 5th grade</td>
<td>EBD</td>
<td>special education math group</td>
<td>44% on-task baseline to 81% on-task VM, 99% on-task VM and SM; disruptive 40% baseline to 11% VM and 0% VM and SM</td>
</tr>
<tr>
<td>Bruhn et al. (2015)</td>
<td>“I don’t like being good!” Changing behavior with Technology-based self-monitoring</td>
<td>ABAB</td>
<td>SM on SCORE-it iPad app on-task and disruptive behavior</td>
<td>1 12 yr old boy, 1 13 yr old girl</td>
<td>ADHD</td>
<td>general education classroom</td>
<td>48.3% to 87.08% on-task; 10% to 5% disruptive behavior</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* SM = self-monitoring. EBD = emotional and behavioral disorders
Table 3 Continued

*Summary of Studies using Technology*

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Design</th>
<th>IV</th>
<th>DV</th>
<th>Students</th>
<th>Diagnosis</th>
<th>Setting</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulchak</td>
<td>Using a Mobile Handheld to Teach a Student with EBD to Self-Monitor Attention</td>
<td>ABAB</td>
<td>SM with Computer</td>
<td>On-Task Behavior</td>
<td>8 yr old male, 3rd grade, European American</td>
<td>EBD</td>
<td>Public elementary school, self-contained classroom</td>
<td>Increased from a mean of 64% on-task behavior to a mean of 98% on-task behavior</td>
</tr>
<tr>
<td>Wills and Mason (2014)</td>
<td>Implementation of a self-monitoring application to improve on-task behavior: A high school pilot study</td>
<td>ABAB</td>
<td>SM on I-connect on-task and disruptive behavior</td>
<td>2 males, 14 and 15 yrs old</td>
<td>ADHD</td>
<td>general education</td>
<td>51% to 95% on-task; 18% to 88% on-task</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* SM= self-monitoring. EBD= emotional and behavioral disorders
researcher. When goal setting, the literature supports selecting and clearly defining target behaviors when teaching students to monitor (Carr & Punzo, 1993; Stainback & Stainback, 1980; Vaughn, Boss, & Schumm, 2000). Goals should be specific, challenging, yet achievable. Goals also should focus on individualized education goals, or behavior that increases the impact upon one’s learning or the learning of others.

**Self-recording.** Self-recording is the act of recording one’s individual behavior. A self-recording form is individualized for the student and their behavior, and can have many designs. Self-recording strategies support students to monitor their own attention, task completion, accuracy, or productivity (Harris et al., 1994; Maag, Reid, & DiGangi, 1993; McCarl, Svobodny, & Beare, 1991). To self-record, previous research typically used a paper-based form that the student completed. The form should include the student’s target behaviors and when they should physically self-record. It is important that the student understands how and when to self-record.

All studies in this review of literature used self-recording. This review supports previous research which indicated that self-recording behavior may have a reactive effect which may be enough of an intervention on its own (Nelson & Hayes, 1981; Shapiro & Cole, 1994). Baer (1984) suggested a reason for behavior improvement may be that self-monitoring provides cues that increase a student’s awareness of potential consequences for a particular behavior. Self-monitoring actively engages the student as the participant, which may lead to improving their behavior (Blick & Test, 1987). Although this intervention has been found to be beneficial for students both with and without a disability, it has been least successful for students with emotional and behavioral disorders. Hughes, Ruhl, and Misra (1989) suggested that students with emotional and behavioral disorders may not want to change their behavior.
**Self-evaluation.** Self-evaluation is when students evaluate their own behavior and discriminate between acceptable and unacceptable behavior. Students must be explicitly taught how to self-evaluate their progress (Vaughn, Bos, & Schumm, 2000). Self-evaluation occasions the student to receive immediate feedback towards their goals (Johnson, Graham, & Harris, 1990). The feedback from self-evaluation often includes graphing their data and evaluating trends, but can extend to seeking feedback from teachers or preferred adults.

Within this review of literature, 9.4% of studies included a self-evaluation component. Digangi, Maag, and Rutherford (1991), and Digangi and Maag (1992) provided prompts for students to tell themselves “I am doing a great job” if 8 to 10 responses were tallied at the end of a session, or “I did okay” if 4 to 7 responses were tallied by the end of the session. No studies included technology-based self-evaluation results and graphs or visual progress. Technology provides immediate feedback with visuals that may occasion self-evaluation without loss of instructional time. Evaluating their own behavior facilitates opportunities for students to discriminate between acceptable and inappropriate behavior. The feedback from self-correcting their own academic performance may lead to evaluating the trends students observe. Trends may be easy to distinguish when students graph their data points and visually analyze the results. Self-evaluating also can lead to evaluation of others, such as teachers, peers, and parents. This may be beneficial to students who seek out attention from others and might possibly experience a greater behavior change when attention and encouragement from others are added.

Accuracy of the student’s self-collected data did not correlate with the student’s behavior change or academic progress, suggesting the act of self-monitoring alone may be more important than data collected correctly (O’Leary & Dubay, 1979). Environmental cues, antecedents, recording devices, and reactivity may influence response performance and frequency (Nelson &
Hayes, 1981; Rachlin, 1974).

**Self-reinforcement.** Self-reinforcement is when an individual delivers to himself a consequence, contingent on his behavior (Goldiamond, 1976). Within this review of literature, no studies included self-reinforcement as an individual component. The goal of self-reinforcement is to reinforce students to use procedures they have been taught to manage and self-reinforce their own behaviors. Students are engaging in the same reinforcement principles for completing the goals defined by their self-monitoring procedures. Nevertheless, Digangi, Maag, and Rutherford (1991), and Digangi and Maag (1992) did provide students prompts paired with self-evaluation. Students self-reinforced themselves with a phrase “I am doing a great job” or “I did okay.” However, students in both studies did not seek out reinforcement in the form of tangibles, attention, or preferred activities. Previous research indicates the effects of reinforcement on preceding behavior is dependent upon whether the student perceives the reward as contingent on their own behavior (Rotter, 1996). Although teachers arrange the contingencies in most classrooms, self-reinforcement occasions students’ opportunities to control the process because of the choice of the reinforcements provided. As external rewards are provided to students, students chose and determine what behaviors to modify, outcomes to achieve, and rewards to earn.

Students with attention-seeking behavior may reach goals for the extrinsic motivation of showing their teacher or parent progress, who may provide positive reinforcement that the student seeks. External reinforcers can vary based on student’s individual motivations which can include, but are not limited to, teacher and peer attention, social reinforcers, or rewards put in place for attaining student goals.
Self-Monitoring Interventions: Multiple Components

Self-monitoring interventions can include any or all of the following components: goal setting, receiving instructions, receiving training, having a self-monitoring device, people commenting on the device, observing behavior, recording behavior, self-evaluating, and self-consequences. Self-monitoring is an effective tool for maintaining and generalizing skills over time because students can perform any component themselves without the need for an adult to help them (Blick & Test, 1987; Quinn, Mathur, & Rutherford, 1996). However, the components to be utilized by the student must first be taught and practiced before expecting the student to implement them correctly and consistently. All studies found in the review of literature specifically taught procedures. This supports previous research that recommends explicit teaching of self-monitoring skills (Stainback & Stainback, 1980) and recommended at a high leverage practice (McLeskey et al., 2017).

Although specific components have not been reviewed further, components of self-monitoring are included in a number of previous reviews of the literature, as shown in Table 1. Intervention packages include both self-monitoring and training. Only three studies included additional components and studied its effects on self-monitoring (Digangi, Magg, & Rutherford, 1991; Digangi & Maag, 1992; Todd, Horner, & Sugai, 1999). All studies indicated that a combination of self-monitoring components were more effective than any specific component used in isolation.

Self-Monitoring Interventions Using Ancillary Supports

Table 2 illustrates five studies that paired self-monitoring with ancillary supports. Germer et al. (2011) used self-monitoring with rewards and praise, Graham-Day, Gardner, and Hsin (2010) paired self-monitoring on-task and behavior with group contingency reinforcement, while

While all studies demonstrated an increase in their dependent variables, results demonstrated a greater change in targeted behavior paired with an ancillary support such as group contingencies or praise. Two students in Graham-Day, Gardener, and Hsin (2010) demonstrated 22% and 32% increase in on-task behaviors when comparing self-monitoring to self-monitoring with group-contingency reinforcers. Similar results were reported in Davis et al. (2014) with an increase of 22% on task when self-monitoring is paired with a token economy rather than self-monitoring as the sole independent variable.

**Cues.** Cues should be intrusive enough to elicit attention for the student to self-monitor yet should not be stigmatizing or distracting to other students in the classroom. If cues are viewed as aversive, there is a reduced chance students will self-monitor in the classroom (Reid, 1996).

All studies within this review of research provided a cue to signal students to self-record. This supports previous research stating behaviors chosen to self-monitor should appeal to the student, be relatively quick to evaluate, should have a least intrusive device, and cues or procedures should not impede with the current learning in the classroom (Carr & Punzo, 1993).

**Self-Monitoring Interventions: Incorporating Technology**

**Technology in Literature.** Only three studies were identified incorporating technology cues and self-monitoring procedures. Diagangi, Maag, and Rutherford (1991) used technology in the form of a tape player emitting random tones in 30 s to 90 s increments. Students self-
monitored on an index card on their desk and plotted their data on a paper graph. Blood and Johnson (2011) used video modeling to teach students to differentiate between appropriate and inappropriate behaviors prior to implementing a self-monitoring intervention. Students watched videos and practiced recording when they observed targeted behaviors. Todd, Horner, and Sugai (1999) used a Walkman tape to prompt students to self-record on a self-management paper-based form. Early cues involved beeps on tape players preset to play at specific intervals. Tape players evolved to devices that are more mobile, allowing students to carry devices set to vibrate to cue the student. Earbuds allowed for louder cues without distracting students in the same class. Eventually cues advanced to be embedded within devices students use daily, such as handheld and laptop computers.

Five studies (Bedesem, 2012; Blood & Johnson, 2011; Bruhn et al, 2014; Gulchak, 2008; Wills & Mason, 2014) also incorporated technology as a part of the self-monitoring intervention, shown in Table 3. The integration of technology ranged from watching a video to identifying behaviors prior to self-monitoring to a cuing students to self-record. Three studies (Bedesem, 2012; Bruhn et al., 2015; Wills & Mason, 2014) required students to self-record directly onto an app using a handheld computer. Bedesem (2012) utilized texting through twitter to send a message directly to a students’ cell phone, and students responded back to the text to self-monitor target behaviors. Bruhn et al. (2015) developed the SCORE IT iPad application that delivered scheduled prompts to the student. Each student self-recorded and was able to view past responses directly on the application, which was shared with the teacher. Willis and Mason (2014) used the I-Connect application to send prompts to an iPad, which required students to self-record “yes” or “no” directly on the device.

Bedesem (2012) and Gulchak (2008) used cell phones or a handheld computer to cue and
record student responses. However, students did not evaluate their behaviors or recorded responses. While previous research studies have used technology for self-monitoring, no study used technology across all components. Technology is used to increase the efficacy of evidence-based practices by allowing one device to cue, to record quickly and unobtrusively directly on the device that students are using, and provide immediate feedback on target behavior with visuals such as graphs and charts.

**Problem Statement**

The incorporation of technology within the instructional components of self-monitoring has been limited. At this time, only a few research studies used current technologies as video feedback to identify target behaviors, auditory or tactile signals to cue students to record, and using the device itself as a means for students to self-record. Current technologies have the potential and the capacity to improve the efficiency of self-monitoring while maintaining effectiveness, as well as occasion self-evaluation.

Today’s technologies can be used in any classroom. For example, Google is found in the classroom through products such as Chromebook and Google Docs, professional development such as Google Educator Certifications, and resources such as grants and partnerships (https://edu.google.com). Google Drive is increasingly popular within the district of study because of its wide availability on any device, free access to Microsoft Office software, ability to share and collaborate with teachers, peers, and parents at home, as well as the ability to download applications and forms from online resources. These applications, tools, and software are constantly updated with the latest security settings and new features guided by the user’s needs and demands. With many school districts moving toward 1:1 technology-based classrooms, students are expected to be literate with any technology and utilize software to best
support their assimilation of the curriculum.

The purpose of the following two-companion studies is to examine the effectiveness and efficiency of incorporating technological-based self-monitoring and evaluation components on task-engagement and disruptive behavior for students in the classroom setting.

**Study I.** The purpose of this study was to compare the effects of recording via paper or technology procedures on task engagement and disruptive behavior for middle school-aged students with disabilities. Specific research questions include:

1. What were the effects of using a paper-based self-recording procedure for middle school students with disabilities on task-engagement and disruptive behavior?
2. What were the effects of using a technology-based self-recording procedure for middle school students with disabilities on task-engagement and disruptive behavior?
3. What were the differential effects of using a paper-based and a technology-based self-recording procedures?
4. What do students think about using paper-based and a technology-based self-recording procedure?

**Study II.** The purpose of this study was to compare the effects of using a paper-based self-graphing procedure or technology-based self-graphing procedures on task engagement and disruptive behavior in a middle school classroom setting. Specific research questions include:

1. What were the effects of using a paper-based self-graphing procedure for middle school students with disabilities on task-engagement and disruptive behavior?
2. What were the effects of using a technology-based self-graphing procedure for middle school students with disabilities on task-engagement and disruptive behavior?
3. What were the differential effects of using paper-based and technology-based self-
4. What do students think about using paper-based and technology-based self-graphing procedures?
Chapter II: Study I

Comparing the Effects of Using a Paper-Based Self-Recording Procedure and a Technology-Based Self-Recording Procedure for Task Engagement and Disruptive Behavior
Self-monitoring is a multicomponent high-leverage practice (McLeskey et al., 2017; Neitzel & Busick, 2009). Components include: (a) goal setting, (b) recording, (c) evaluation, and (d) feedback, reinforcement, and instructions to achieve new goals (Digangi, Maag, & Rutherford, 1991; Digangi & Maag, 1992; Fantuzzo et al., 1988; Hayes & Nelson, 1977; 1981; Kanfer, 1970; Todd, Horner, & Sugai, 1999). Self-monitoring has been used successfully to improve task-engagement and academic outcomes, as well as reduce targeted classroom behavior (Nelson & Hayes, 1981; Shapiro & Cole, 1994). Self-monitoring also has been used successfully for students with emotional behavioral disorders (EBD), attention deficit disorder (ADD), and mild disabilities (Reid & Harris, 1993). Nelson (1977) suggested that the positive behavior change in part is a result of reactivity or becoming more aware of one’s behavior through the process of self-monitoring and recording a target behavior. The system of self-recording influences the frequency of the behavior identified for change (Nelson & Hayes, 1981; Rachlin, 1974).

In most self-monitoring studies, a paper-based recording form was used. The incorporation of technology for self-monitoring has been limited, especially as a recording and evaluation tool. Blood et al. (2011) used video modeling to teach one 10-year-old boy how to identify and record target behaviors, however the video modeling only occurred prior to self-recording procedures. Using video modeling, on-task behavior varied across sessions. The addition of paper-based self-monitoring procedures helped increase on-task behavior and decrease disruptive behavior.

Bedesem (2012) sent scheduled texts in 1 min intervals to students’ mobile device as a cue to self-monitor. Students responded to pre-set questions by tweeting back to the teacher, but were unable to view their own student responses once the tweet was sent back to the teacher.
Gulchak (2008) also evaluated the use of a mobile device for one student’s on-task behavior. Tones were uploaded to a device, where only the student could hear through earbuds, reminding him to self-monitor ‘yes’ or ‘no’ to prompts asking about on-task behavior. Although this these studies used technology to cue and self-record, the students did not evaluate their own behavior.

The use of technology within the today’s classroom is becoming more of a necessity than an option. Classroom technologies provide the ability to share documents and collaborate in real-time with students, teachers, administrators, and parents. Google Drive is available on many devices, which includes free access to Microsoft Office software, and the capabilities to share and download online resources. With many classrooms moving toward a 1:1 technology-model, students are expected to be literate with any technology and utilize software to best support their assimilation of the curriculum.

Google Forms© is a free online program which is customizable to create individualized questions that include multiple-choice, short answer, checkbox, dropdown, and linear scale questions customizable to any target behavior. A link is created which is used to access a questionnaire tailored to individual students’ target behavior. Automatic graphing can be toggled ‘on’ and ‘off’ by the form creator, determining if the answers are represented in graph or chart once students send their responses. Data are viewable from any device with access to the internet and not limited to the specific device each student uses.

The feedback from self-graphing their own academic problems can occasion students to evaluate trends. Trends are easiest to distinguish when students graph their own individualized data points and can analyze the results visually in a chart or graph form.
Purpose and Research Questions

The purpose of the first study was to examine the effectiveness and efficiency of incorporating technological-based self-monitoring and evaluation components.

Study I. The purpose of this study was to compare the effects of a paper-based self-recording procedure or a technology-based self-monitoring procedure on task engagement and disruptive behavior for middle school aged students with disabilities. Specific research questions include:

1. What were the effects of using a paper-based self-recording procedure for middle school students with disabilities on task-engagement and disruptive behavior?
2. What were the effects of using a technology-based self-recording procedure for middle school students with disabilities on task-engagement and disruptive behavior?
3. What were the differential effects of using a paper-based and a technology-based self-recording procedure?
4. What do students think about using paper-based and a technology-based self-recording procedure?

Method

Setting and Participants

All participants attended a public, urban middle school in the southeast United States with a population of almost 900 students across sixth, seventh, and eighth grades. All phases occurred in a special education math classroom setting that consisted of 11 students with disabilities. The purpose of the class was to provide grade level curriculum and close learning gaps.

Four middle-school aged students with specific learning disabilities participated in both
studies. Two males (Adam and Brad) and two females (Claire and Dawn) participated. Students were asked to participate based on teacher recommendations, and demonstrating low levels of task engagement and high levels of disruptive behavior. Table 4 lists participants’ academic characteristics measured by WISC-IV (Wechsler, 2003), KTEA-II (Kaufman & Kaufman, 2013) and WIAT-II (Wechsler, 2001).

The primary researcher was a doctoral candidate and the classroom teacher. She collected all data and implemented procedures across all phases of this study. A teaching assistant assisted by collecting data. The researcher has a Master’s degree in special education and teaching endorsements in special education, elementary and secondary science education. Within the past eight years, the researcher primarily taught students with learning and emotional disabilities. The teaching assistant has been a teaching assistant for students with special needs for over 20 years. The teaching assistant has been assisting in data collection for 6 years and was trained in specific data collection procedures prior to the start of the study. A second teaching assistant collected interobserver reliability (IOR) and procedural integrity data. She has been assisting in data collection for four years and was trained in all procedures prior to the start of the study.

**Functional Assessment.** Functional behavioral assessments (FBA) had been conducted as part of their educational programming on all four participants by the district behavior liaison within a year of conducting the present study. For all four students, the FBA results indicated that the primary function of their problem behaviors were to obtain attention from peers and/or adults. Interviews with students, interviews with teachers, direct observations in multiple settings, review of conduct records, data collections supported the hypothesis statements for each of the students. Table 5 lists participants’ behavior characteristics as measured by ABAS-II (Harrison & Oakland, 2003) and ABAS-III (Harrison & Oakland, 2015).
Table 4

*Participant Academic Characteristics*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Disability</th>
<th>IQ</th>
<th>Academic Achievement Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>11 years, 10 months</td>
<td>SLD: Reading Fluency, Math Calculation</td>
<td>78</td>
<td>WISC-IV: reading fluency:63 math calculation:80</td>
</tr>
<tr>
<td>Brad</td>
<td>12 years, 6 months</td>
<td>SLD: Math Calculation</td>
<td>84</td>
<td>KTEA-II: Math calculation: 60</td>
</tr>
<tr>
<td>Claire</td>
<td>12 years, 4 months</td>
<td>ADHD</td>
<td>81</td>
<td>WIAT-III: Reading comprehension: 83 Math problem solving: 75 Word Reading: 88 Numerical Operations: 64</td>
</tr>
<tr>
<td>Dawn</td>
<td>12 years, 7 months</td>
<td>SLD: Math Calculation Language Impairment</td>
<td>89</td>
<td>WIAT-III: Math problem solving: 60 Numerical operations: 68</td>
</tr>
</tbody>
</table>

*Note:* SLD: specific learning disability. ADHD: attention deficit hyperactive disability
Table 5

**Participant Behavior Characteristics**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Adaptive Behavior Scores</th>
<th>Functional Behavior Assessment Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Function of Behavior</td>
</tr>
<tr>
<td>Adam</td>
<td>ABAS-III Home: 63; School: 60</td>
<td>Peer Attention</td>
</tr>
<tr>
<td>Brad</td>
<td>n/a</td>
<td>Adult Attention</td>
</tr>
<tr>
<td>Claire</td>
<td>ABAS-III Home: 67; School: 82</td>
<td>Attention</td>
</tr>
<tr>
<td>Dawn</td>
<td>ABAS-II Home: 85; School: 63</td>
<td>Attention</td>
</tr>
</tbody>
</table>

*Note: ABAS: Adaptive Behavior Assessment System*
Adam. Adam was an 11 year, 10 months old African American male diagnosed with a specific learning disability (SLD) in reading fluency and math calculation since third grade. Adam has a full scale IQ of 78 with peer attention as one of the reasons he exhibits disruptive behavior during class. Adam received all core instruction in the general education classroom with modified support in math. Attention-seeking behavior exhibited in the classroom include out-of-seat behavior and refusal to follow directions after multiple prompts.

Brad. Brad was a 12 year, 6 months old Caucasian male with a full scale IQ of 84. He has received special education series for SLD in math calculation since age 5. Brad’s FBA indicated that he seeks adult attention. Brad receives core instruction in the general education classroom with modified support in a general education math classroom. Attention-seeking behavior such as out-of-seat and walking up to the teacher during instruction have been observed in all core subject areas.

Claire. Claire was a 12 year, 4 months old Caucasian female with a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) since the age of 8. Claire’s full-scale IQ is 81. Claire receives core instruction in the general education classroom with adapted support in mathematics and language arts special education classroom. Her FBA indicated attention seeking behavior in the form of talking out and out of seat behavior.

Dawn. Dawn was a 12 years, 7 months old Caucasian female. She was diagnosed with a SLD in mathematic calculations with a secondary disability diagnosis of language impairment since age 9. Her full-scale IQ was 89, and her FBA indicated attention-seeking behavior that included out-of-seat behavior and increased talking out during instruction. Dawn received adapted supports in mathematics special education classroom and supports within the general education classroom for all other core courses.
Materials

Materials included a paper and pencil self-monitoring form (see figure 1), four stopwatches, and five Chromebooks. Chromebooks were provided to all students as a 1:1 school technology initiative. All students were familiar with using digital devices for academic tasks and have used these devices across multiple classroom settings. Each student, as well as the classroom teacher, had their own Chromebook. Each Chromebook had 16GB, weighed less than a pound, had wireless access, and retailed at $208. All students had free access to Google Drive and its components through their email provided by the school district. Preloaded on each Chromebook was the Google Forms© application, a timer application, and minimal access to other applications on the device. Google Forms© is a free application that allowed the target behaviors to be customizable for each student’s specific target behavior. Google Forms© that allowed students to answer self-monitoring questions at the end of a task and automatically record their answers within a digital format. The digital self-monitoring form was the same as the paper and pencil form in Figure 1.

Independent Variables

The independent variables were the paper-based and technology-based monitoring procedures. For both procedures, the teacher verbally prompted the students after 20min to respond to the following questions using via paper-based or technology-based procedures: (a) How well do I understand the material from today? (b) Did I complete my notes? (c) How was I feeling today? (d) Did I finish my homework? and (e) Did I listen when the teacher was talking in class? Figure 1 is an example of the self-recording form.
Figure 1. Paper-based and Google-form self-monitoring questions as viewed by student.
**Paper-based Intervention.** During paper-based procedures, students were given a paper-based form at the start of class that they kept on their desk. Every 20 min, the teacher verbally prompted students to self-record due to a natural break during instruction when students transition from independent work to small group time.

**Technology-based intervention.** During technology-based procedures, students were given a Chromebook and were prompted to turn it on and access the Google Forms© application upon entering the classroom. Each Google Form application was individualized to target each student’s behaviors. The Chromebook timer was enabled to make a quiet sound or small vibration every 20 min to cue students to record their behavior. Students self-recorded using the Google Form.

**Dependent Variables and Data Collection**

The three dependent variables were: (a) percentage of intervals of on-task, (b) percentages of intervals of disruptive behavior, and (c) time required to self-monitor procedures. Data were collected during the first 20 min of independent work. Both the classroom teacher and teaching assistant collected data. Each day, two students were randomly assigned to be observed by the teacher and the other two students were assigned to be observed by the teaching assistant.

**On-Task.** On-task was defined as (a) being in one’s own seat, (b) looking at materials or the teacher, or (c) writing related to the assigned task. Data were collected using a 25 s momentary time sampling procedure with 5 s for the observer to record the behavior. At the end of each 25 s interval, the teacher looked at two of the four students and recorded a “+” if they were on-task or a “−” if they were not on-task. Likewise, the teaching assistant recorded data using the same procedures for the other two students. The total number of on-task occurrence intervals was then divided by the total intervals possible (i.e., 40 intervals) to calculate the
percentage of on-task occurrence intervals.

**Disruptive behavior.** Disruptive behavior were defined as (a) making inappropriate noises, (b) talking without permission, and (c) gesturing inappropriately to others. Data were collected using a 25 s partial interval recording procedure and 5 s for the observer to record the behavior. The teacher observed two of the four students and recorded a “+” if they were observed demonstrating a disruptive behavior or a “-” if they were not observed being disruptive during each 25 s interval. Likewise, the teaching assistant recorded data using the same procedures for the other two students. The total number of disruptive occurrence intervals was then divided by the total number of intervals possible (i.e., 40 intervals) to calculate the percentage of occurrence intervals of disruptive behavior.

**Time required to Implement Self-Monitoring.** Time required to implement self-monitoring procedures were used to collect the amount of time required for students to self-monitor their on-task performance. The teacher started a stopwatch after prompting students to self-monitor. The amount of time required for students to self-monitor was recorded using a stopwatch. The teacher and teacher assistant both had two stopwatches, for a total of four stopwatches. Each stopwatch was assigned to one participant and time started when the student began self-recording and stopped after the last question was answered.

**Design and Treatment Conditions**

An alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to determine if the use of a technology-based self-recording procedure or a paper-based self-recording procedure would have more of a positive effect. This design provides comparison of two or more treatments to examine which treatment is more effective and/or efficient, while maintaining experimental control. First, baseline probes were collected regarding each student's
on-task behavior and instances of disruption. For the alternating treatments phases, one of two interventions (technology or paper) was applied each day. Additionally, a baseline probe or no-intervention probe was conducted at least once per week to examine possible carryover effects. For the first week, the researcher randomly assigned treatments resulting in two days of one treatment and two days of the second treatment. Baseline procedures or no-intervention probes were included randomly once per week. This strategy was used to increase the probability that students would be able to distinguish between and learn each treatment procedure. During the following weeks, the researcher continued to randomize the treatments implemented to include two days of technology, two days of paper implementation, and one day of no-intervention in random order.

**Procedures**

**Training.** Prior to this research, students participated in a training phase. Students were instructed on how to operate the computer and access Google Forms©. No self-recording occurred during the training procedures. Students were instructed to physically turn on the device and to select the desktop shortcut, which provided immediate access to the self-monitoring application. The teacher modeled the necessary steps to access the application. The students were considered trained if they could independently access the application, and answer the questions presented for three consecutive sessions. All students successfully operated the device, access the self-monitoring application, and responded to the questions for three consecutive sessions.

Additionally, before baseline, students were taught to differentiate between on-task and off-task behavior using a self-monitoring paper-pencil sheet. Training on self-monitoring procedures occurred for three 10 min sessions. Students were asked to identify if a behavior was “on-task” or “off-task” after hearing a teacher read classroom scenario. The teacher also modeled
to the students how to complete the self-recording form (see Figure 1). Students then practiced completing the form. Students were considered trained when they responded correctly in three consecutive sessions. All students successfully differentiated between on-task and off-task classroom scenarios and completed the self-recording form correctly for three consecutive sessions.

**General classroom procedures.** At the beginning of each class, the teacher led a whole class lesson for approximately 10 min. Afterward, students were expected to work independently for 20 min. During this time, student observations were recorded. At the end of 20 min, the teacher or Chromebook timer cued the students to self-monitor depending upon which intervention was in place.

**Baseline.** During baseline, students did not self-record their behavior. Neither the paper-based nor the technology-based recording procedures were implemented. Usual classroom procedures were in place. The teacher collected student on-task and disruptive behavior using a 25 s partial interval recording procedure and 5 s for the observer to record the behavior for a minimum of three sessions or until the data were considered stable. Stability was determined using Gast’s (2010) “80%-20%” criteria, where data are considered stable when 80% of the data points fall on or within 20% of the median baseline value.

**Paper-based intervention.** Students were given a self-recording paper-based form that they kept on their desk. Using a stopwatch, the teacher verbally cued students after 20 min to record if they were on-task as well as respond to the self-recording questions with paper and pencil. The teacher continued to collect student on-task and disruptive behavior using observation recording methods similar to baseline. (see Appendix A).
**Technology-based intervention.** Students were given a Chromebook and were prompted to turn it on and access the Google Forms© application upon entering the classroom. The Chromebook timer was enabled during intervention. After 20 min the timer alerted students to respond to the self-recording questions. The alert made a quiet sound or small vibration after 20 min. Students would self-record directly on Google Forms©. Similar to previous phases, the teacher recorded each student’s on-task and disruptive behavior using a 25 s partial interval recording procedures with a 5 s interval for the observer to record the behavior.

**Analysis Procedures**

Visual analysis procedures were used to evaluate the results of the alternating self-monitoring conditions across on-task and disruptive behavior. To assess intervention effects, six indicators were used to examine within-phase and between-phase data patterns including analyzing (a) trends, (b) levels, (c) variability, (d) immediacy of effect, (e) consistency of data patterns, and (f) effect size across phases. Within-phase comparisons were evaluated to assess predictable patterns of data, data from adjacent phases were used to assess whether manipulation of the independent variable was associated with change in the dependent variable, and data across all phases were used to document a functional relation (Gast, 2012). Horner et al. (2005) states that a functional, or causal, relation is demonstrated after at least three occurrences of an effect over a minimum of three different points in time are observed.

Providing effect size measures allows investigators to compare these findings with other research. Effect size was calculated with Tau-U, which is the percentage of non-overlap minus overlap, ranging from -1 to 1 (Soloman, Howard, & Stein, 2015). Tau-U takes trend and non-overlapping data into account, correlates with nonparametric indices, and can identify and accommodate baseline trend if it exists (Parker et al., 2011; Vannest et al., 2016). Effect size was
calculated using a web-based application developed by Vannest and colleagues to calculate between (a) Condition 1 and Condition 2, (b) Condition 1 and Condition 3, and (c) Condition 2 and Condition 3. Baseline treatment was combined with no-treatment conditions to account for Condition 1. Effect size coefficients were interpreted based on Vannest and Ninci (2015) suggested guidelines: “0.20 improvement may be considered a small change, 0.20 to 0.60 a moderate change, 0.60 to 0.80 a large change, and above 0.80 a very large change” (p. 408).

**Interobserver Agreement and Procedural Integrity**

Data for inter-observer agreement (IOA) were collected with a second teaching assistant observing independently and simultaneously. The second teaching assistant was trained on data collection procedures and familiar with this study, collecting IOA data with both the teacher and first teaching assistant. Interobserver agreement was calculated by dividing the number of agreements of participant responses by the number of agreements plus disagreements and multiplying by 100. IOR was defined as 90% or greater, and if IOA fell below 90%, the two observers would have reviewed all steps together until IOA reached determined criteria. During this study, IOA did not fall below 97% for on-task or disruptive behavior.

Inter-observer reliability data were collected during a minimum of 20% of sessions across baseline and alternating treatments phases for each student. For each session, observers individually scored intervals of on-task behavior and disruptive behavior for each student. For on-task behavior, the number of agreed occurrence intervals was divided by the sum of agreed and disagreed occurrence intervals and then multiplied by 100 for each student. The same was computed for disruptive behavior. IOA for seconds to self-monitor was considered in agreement if the times were within 2 s of each other. On-task IOA ranged from 97% to 99% ($M = 98\%$): Adam’s IOA was 98% ($M = 99\%$), Brad’s IOA was 97% ($M = 98\%$), Claire’s IOA was 99% ($M = 98\%$).
Disruptive behavior IOA ranged from 97% to 100% (\(M = 99\%\)): Adam’s IOA was 99% (\(M = 99\%\)), Brad’s IOA was 99% (\(M = 99\%\)), Claire’s IOA was 97% (\(M = 98\%\)), and Dawn’s IOA was 100% (\(M = 100\%\)).

Procedural integrity measures were used to determine the classroom teacher’s accuracy in performance according to the research procedures. The classroom teacher’s behavior included having all materials available and verbally cuing the students after 20 min during the paper-based intervention (see Appendix B). Scores for the procedural agreement levels were calculated by dividing the number of observed teacher behavior by the number of planned teacher behavior and multiplying by 100 (Billingsley, White, & Munson, 1980). The mean procedural reliability agreement was 100% during the paper-based intervention, and 100% during the technology-based intervention.

Social Validity Measure

Following the completed intervention, all four students, the researcher, and the teaching assistant who participated in this study were asked to complete a 14-item social validity questionnaire (see Appendices C and D) using a Likert-type scale (Likert, 1932). The Likert-type scale ranges from 1- strongly disagree to 6- strongly agree. Higher scores indicated more acceptability. Questions addressed the ease of access, the immediate feedback available, intrusion of technology in the classroom, and the likelihood of using the materials in the future. A section for written comments was added for both teachers and students to provide additional information and thoughts about the study.

Results

Figures 2, 5, 8, and 11 display the results of each participant's on-task behavior across phases. During baseline, Adam, Brad, and Claire’s on-task behavior were below 80% with a
downward trend. Dawn’s on-task performance trended flat at 70% for three consecutive sessions prior to the alternating treatments phase. During the alternating treatments phase, on-task improvement varied across students. Results indicate that students using technology increased on-task better or equal to paper-based self-monitoring.

Figures 3, 6, 9, and 12 display the results for each participant’s disruptive behavior for each intervention treatment. Data indicate baseline was more variable with ranges of disruptive behavior. Results indicate that students using technology decreased disruptive behavior better or equal to paper-based self-monitoring.

Figures 4, 7, 10, and 13 display the results regarding how long it took each student to self-record using paper-based and technology self-recording procedures. The cumulative number of seconds of each intervention implementation is displayed. Visual analysis indicated the technology-based intervention was more efficient and required less time to implement for all participants. Across all four participants, the technology-based intervention averaged 30 s less time to implement per session than paper and pencil, with an overall average of 3.9 minutes faster to implement across all sessions. Table 6 provides ranges, means, and standard deviation for on-task performance across students. Table 7 provides effects sizes across conditions as measured by Tau-U for on-task performances across all 4 students.

On-task performance increased for all students using either intervention from baseline. Baseline during alternating treatment phase or no-intervention probe maintained similar levels for Adam, Claire, and Dawn. Brad’s no-intervention probe decreased slightly below his original baseline level. All students gained higher levels of on-task performance with technology interventions than with paper and pencil. Claire demonstrated the largest increase in on-task performance using paper and pencil than any other phase.
Figure 2. Adam’s percentage of on-task occurrence intervals across baseline and alternating treatments.

Figure 3. Adam’s percentage of intervals scored disruptive behavior across baseline and alternating treatments.
Figure 4. Adam’s seconds to self-monitor.

Figure 5. Brad’s percentage of on-task occurrence intervals across baseline and alternating treatments.
Figure 6. Brad’s percentage of intervals scored disruptive behavior across baseline and alternating treatments.

Figure 7. Brad’s seconds to self-monitor.
Figure 8. Claire’s percentage of on-task occurrence intervals across baseline and alternating treatments.

Figure 9. Claire’s percentage of intervals scored disruptive behavior across baseline and alternating treatments.
Figure 10. Claire’s seconds to self-monitor.

Figure 11. Dawn’s percentage of on-task occurrence intervals across baseline and alternating treatments.
Figure 12. Dawn’s percentage of intervals scored disruptive behavior across baseline and alternating treatments.

Figure 13. Dawn’s seconds to self-monitor.
Table 6

**Average On-Task Performance for Baseline and Intervention Phases**

<table>
<thead>
<tr>
<th></th>
<th>Baseline M (SD)</th>
<th>Baseline Range</th>
<th>Paper/Pencil M (SD)</th>
<th>Paper/Pencil Range</th>
<th>Technology M (SD)</th>
<th>Technology Range</th>
<th>Alternating Treatments M (SD)</th>
<th>Alternating Treatments Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>Range</td>
<td>M (SD)</td>
<td>Range</td>
<td>M (SD)</td>
<td>Range</td>
<td>M (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Adam</td>
<td>54.0% (4.2)</td>
<td>50%-65%</td>
<td>76.3% (3.5)</td>
<td>70%-80%</td>
<td>87.5% (6.0)</td>
<td>75%-90%</td>
<td>58.8% (6.3)</td>
<td>50%-65%</td>
</tr>
<tr>
<td>Brad</td>
<td>53.0% (9.1)</td>
<td>45%-65%</td>
<td>78.8% (3.5)</td>
<td>75%-85%</td>
<td>86.3% (8.8)</td>
<td>70%-95%</td>
<td>52.5% (2.9)</td>
<td>50%-55%</td>
</tr>
<tr>
<td>Claire</td>
<td>38.0% (5.7)</td>
<td>30%-45%</td>
<td>62.5% (12.0)</td>
<td>40%-80%</td>
<td>68.1% (8.0)</td>
<td>60%-80%</td>
<td>38.8% (12.5)</td>
<td>20%-45%</td>
</tr>
<tr>
<td>Dawn</td>
<td>71.0% (2.2)</td>
<td>70%-75%</td>
<td>93.1% (4.6)</td>
<td>85%-100%</td>
<td>95.6% (4.2)</td>
<td>90%-100%</td>
<td>86.3% (2.5)</td>
<td>85%-90%</td>
</tr>
</tbody>
</table>

Table 7

**Tau-U Effect size for On-Task Performance across Conditions and Phases**

<table>
<thead>
<tr>
<th>Comparisons</th>
<th>Baseline-Paper/Pencil</th>
<th>Baseline-Technology</th>
<th>Paper/Pencil-Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>1.00 (Very Large)</td>
<td>1.00 (Very Large)</td>
<td>0.84 (Very Large)</td>
</tr>
<tr>
<td>Brad</td>
<td>1.00 (Very Large)</td>
<td>1.00 (Very Large)</td>
<td>0.56 (Moderate)</td>
</tr>
<tr>
<td>Claire</td>
<td>0.86 (Very Large)</td>
<td>1.00 (Very Large)</td>
<td>0.28 (Moderate)</td>
</tr>
<tr>
<td>Dawn</td>
<td>0.64 (Large)</td>
<td>0.71 (Large)</td>
<td>0.30 (Moderate)</td>
</tr>
</tbody>
</table>
Effect sizes were “very large” for Adam, Brad, and Claire, and “large” for Dawn comparing baseline to either intervention. Paper and pencil compared to technology resulted in “moderate” effect sizes for Brad, Claire, and Dawn, and “very large” for Adam. Table 8 provides ranges, means, and standard deviation for disruptive behavior performance across students. Table 9 provides effects sizes for behavior performance across conditions as measured by Tau-U.

The average percentage of intervals scored for disruptive behavior decreased for all students using either paper-based or technology-based procedures. However, disruptive behavior decreased on average more using technology. Two students, Adam and Claire, maintained similar baseline levels during the alternating treatments no-intervention baseline probes. Brad’s alternating treatment baseline averages exceeded his original baseline averages by over 10%, suggesting Brad’s disruptive behavior increased despite interventions. Dawn was the only student to maintain lower alternating treatments baseline averages compared to all students, suggesting carryover effects. The largest differences in averages fell between baseline and technology intervention phases.

Effect sizes across students and baseline to paper and pencil ranged from “moderate” for Brad and Dawn to “large” for Adam and Claire. Adam and Claire maintained “very large” effect size comparing baseline to technology. Tau-U effect size indicates smaller effect sizes between the two intervention phases than either intervention compared to baseline.

Adam. Figure 2 displays Adam’s results of on-task performance. During baseline, Adam’s on-task performance averaged 54%, demonstrating a downward baseline trend. During the paper-based intervention, Adam’s on-task behavior improved to an average of 76.3%. During the technology-based intervention, Adam’s on-task behavior averaged of 87.5%. Both interventions demonstrated a 100% non-overlapping data (Scruggs et al., 1987). Adam’s on-task
Table 8

Average Behavior Performance for Baseline and Intervention Phases

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline</th>
<th>Paper/Pencil Self-Recording</th>
<th>Technology Self-Recording</th>
<th>Alternating Treatments Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
</tr>
<tr>
<td>Adam</td>
<td>38.0% (6.7)</td>
<td>16.9% (6.5)</td>
<td>10.6% (4.2)</td>
<td>26.3% (8.5)</td>
</tr>
<tr>
<td></td>
<td>30%-45%</td>
<td>10%-30%</td>
<td>5%-15%</td>
<td>15%-35%</td>
</tr>
<tr>
<td>Brad</td>
<td>16.0% (8.2)</td>
<td>11.3% (7.9)</td>
<td>10.6% (4.2)</td>
<td>26.3% (8.5)</td>
</tr>
<tr>
<td></td>
<td>5%-25%</td>
<td>0%-20%</td>
<td>5%-15%</td>
<td>15%-35%</td>
</tr>
<tr>
<td>Claire</td>
<td>61.0% (10.8)</td>
<td>43.1% (11.0)</td>
<td>39.4% (5.0)</td>
<td>57.5% (19.3)</td>
</tr>
<tr>
<td></td>
<td>45%-75%</td>
<td>25%-60%</td>
<td>35%-45%</td>
<td>40%-85%</td>
</tr>
<tr>
<td>Dawn</td>
<td>31.0% (4.2)</td>
<td>6.9% (4.6)</td>
<td>5.0% (4.6)</td>
<td>7.5% (2.9)</td>
</tr>
<tr>
<td></td>
<td>35%-35%</td>
<td>0%-15%</td>
<td>0%-10%</td>
<td>5%-10%</td>
</tr>
</tbody>
</table>

Table 9

Tau-U Effect size for Behavior Performance across Conditions and Phases

<table>
<thead>
<tr>
<th>Students</th>
<th>Baseline-Paper/Pencil</th>
<th>Baseline-Technology</th>
<th>Paper/Pencil-Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.67</td>
<td>0.81</td>
<td>0.59</td>
</tr>
<tr>
<td>Adam</td>
<td>(Large)</td>
<td>(Very Large)</td>
<td>(Moderate)</td>
</tr>
<tr>
<td>Brad</td>
<td>0.56</td>
<td>0.64</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>(Moderate)</td>
<td>(Large)</td>
<td>(Small)</td>
</tr>
<tr>
<td>Claire</td>
<td>0.65</td>
<td>0.86</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>(Large)</td>
<td>(Very Large)</td>
<td>(Moderate)</td>
</tr>
<tr>
<td>Dawn</td>
<td>0.39</td>
<td>0.47</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>(Moderate)</td>
<td>(Moderate)</td>
<td>(Moderate)</td>
</tr>
</tbody>
</table>
behavior continued to perform at low levels with no intervention as indicated by an average of 58.8% occurrence intervals.

Both interventions demonstrated an immediate effect higher than baseline. Paper and pencil procedures maintained a stable trend above 70%, yet never reaching 100% on-task occurrence intervals. Technology procedures reached 100% once, but maintained 80% or above for the last 6 points, indicating technology was more effective. No-intervention phase continued to remain below 70% of on-task occurrence intervals.

Figure 3 displays Adam’s results for the percentage of intervals scored disruptive behavior across baseline and alternating treatments phases. Adam had 30% to 45% disruptive behavior during baseline and average of 38% occurrence intervals of disruptive behavior. During the paper-based intervention, Adam’s disruptive behavior decreased to a mean of 16.9%. During the technology-based intervention, Adam’s disruptive behavior decreased to a mean of 10.6% occurrence intervals. Adam’s disruptive behavior continued to perform at high levels with no intervention as indicated by an average of 26.3% occurrence intervals of disruptive behavior.

Both interventions demonstrated an immediate decrease of intervals scored disruptive behavior, with disruptive behaviors returning near baseline levels using paper-based procedures. Technology procedures maintained 20% or lower intervals scored disruptive behaviors for the duration of the study, and accounted for the lowest disruptive behavior intervals compared to paper and pencil procedures. Paper and pencil procedures demonstrated an upward trend for the last three data points. Effect size between technology and paper procedures indicated “moderate” change compared to “very large” effect size between technology and baseline.

Figure 4 displays the total number of seconds to self-monitor for Adam across treatment conditions. The paper-based intervention required a total of 378 s for the 8 intervention sessions,
whereas 186 across the 8 intervention sessions was required for the technology-based intervention. The technology-based provided a more efficient rate of implementation with an average of 24 s per session while resulting a higher percentage of on-task performance. At 20 min per session, the technology intervention saves 432 s every 6.5 hour school day.

**Brad.** Figure 5 displays Brad’s percentage of on-task occurrences intervals. During baseline, he averaged 53% on-task intervals occurrences ranging from 45% to 65% and a downward trend was observed before implementing the alternating treatments. During the alternating treatments phase, Brad’s percentage of on-task occurrences rose to an average of 86.3% with technology and 78.8% on-task with paper-based self-monitoring procedures. Both treatments continued to be more effective than baseline, which maintained an average of 52.5% on-task occurrences across the treatment phases.

Both technology and paper-based procedures demonstrated immediate rise to 80% on-task occurrence intervals. However, a bifurcation between the two interventions data paths occurred for the last three data points favoring technology. Paper and pencil procedures showed more stable data through the entire intervention, but technology treatment procedures reached on-task performance above 90%.

Figure 6 displays Brad’s results of percentage of intervals scored disruptive behavior. During baseline, Brad had range from 5% to 25% during baseline. Brad averaged 16% intervals of disturbances per session in baseline which increased to 36.3% occurrence intervals of disturbances during baseline within the alternating treatments phase. With the use of technology self-monitoring, Brad decreased his average number of disruptive behavior to 10.6% occurrence intervals per session, while paper-based intervention showed Brad’s disruptive occurrences decreasing to an average of 11.3% per session.
Brad’s baseline variability ranged from 5% to 25% with an average of 16% intervals scored disruptive behavior, which increased to 26.3% in no-intervention phase during alternating treatment conditions. Both interventions did not have an immediate effect compared to baseline. Trends for both interventions maintained low percentages of disruptive behavior, with paper and pencil reaching no disruptive behavior occurrences on two occasions. Tau-U effect size, corrected for baseline trends, indicated a larger effect size for technology than paper-based when comparing to baseline. Both interventions demonstrated a “small” effect size when compared to each other, which could be attributed to low baseline percentages prior to the start of the study.

Figure 7 displays Brad’s seconds to self-monitor. During the first session of technology treatment, Brad completed his self-monitoring in 22 s, while paper and pencil completion took 55 s. Over the course of 8 sessions for each treatment, Brad’s implementation time was 154 s total for technology and 445 s for paper and pencil.

Technology provided a faster rate of implementation at an average of 36.4 s per session while supporting a higher percentage of on-task occurrences of 86.3% for technology compared to 79% for paper and pencil. At 20 min per session, the technology intervention saves 709.8 seconds every 6.5 hour school day. In a 200 day school year, using technology has saved 2,366 minutes, or 39.4 hours of instruction per school year if used continuously. Brad’s total number of disturbances with technology were lower at 2.1 disturbances per session as compared to 2.3 disturbances per session using paper and pencil.

Claire. Figure 8 displays Claire’s results of on-task percentages. During baseline, Claire had a downward trend of on-task occurrences that averaged 38% across 5 sessions. During the intervention phases, no-intervention procedures average increased to an average of 38.8% on-task while the interventions increased Claire’s on-task percentage to 68.1% with the use of
technology self-monitoring, and 62.5% with the use of paper-based self-monitoring procedure.

Technology treatment conditions demonstrated an immediate effect above 60% on-task occurrence intervals, with paper-based conditions at 75% on-task occurrence intervals. Paper and pencil procedures quickly demonstrated a downward trend below 70% and maintained lower percentages throughout the study. Technology rose to 80% on-task occurrence intervals and maintained an upward trend, suggesting a preference for technology-based procedures.

Figure 9 displays Claire’s percentage of intervals scored disruptive behavior, with baseline data ranging from 45% intervals of disturbances to 75% disruptive occurrence intervals. Claire averaged 61% disturbance intervals per session in baseline which decreased to 57.5% average disturbance intervals per session during baseline or no-intervention probes within the alternating treatments phase. With the use of technology self-monitoring, Claire decreased her average percent of disruptive behavior to 39.4% intervals per session, while paper and pencil self-monitoring intervention showed Claire’s disruptive occurrences decreasing to an average of 43.1% intervals per session.

Visual analysis of Claire’s data indicates a trend of disturbances having a smaller variability of disturbance occurrences with technology self-monitoring whereas both baseline and paper and pencil treatment account for larger variability of disturbances. Tau-U effect sizes indicate a “large” effect between baseline and paper and pencil procedures, and a “very large” effect size between baseline and technology. When comparing both intervention conditions, there was a “moderate” effect. Both interventions maintained 35% to 40% for the last few data points, indicating that either intervention was effective for Claire.

During the first session of technology treatment, Claire completed her self-monitoring in 30 s, while paper and pencil completion took 56 s as shown in Figure 10. Over the course of 8
sessions for each treatment, Claire’s implementation time was 243 s total for technology and 487 s for paper-based. Technology provided a faster rate of implementation at an average of 30.5 s per session while supporting a higher percentage of on-task occurrences of 68% for technology compared to 62.5% for paper and pencil. At 20 min per session, the technology intervention saves 567.3 s every 6.5 hour school day.

**Dawn.** Figure 11 displays Dawn’s percentage of on-task occurrences with a baseline of 71% on-task ranging from 70% to 75% and a downward trend before implementing alternating treatments. Dawn continuously demonstrated on-task behavior below 80%. During the alternating treatments phase, Dawn’s percentage of on-task occurrences rose to an average of 95.6% with technology and 93% on-task with paper and pencil which increased to an average of 86% on-task occurrences across the treatment phases.

Dawn showed immediate improvement above 80% with both intervention treatments. However, no intervention probes also demonstrated trends above 80%, indicating a possible spill-over effect. Paper and pencil treatment resulted in increasing trends and reached 100% on-task occurrence intervals and maintained at 95% for the remaining of the study. Trends with technology treatment indicated a slow rise resulting in more 100% on-task occurrence intervals compared to paper-based treatment.

Figure 12 displays Dawn’s percentage of intervals scored disruptive behavior. During baseline, Dawn’s percent of disruptive behavior averaged 31% occurrences per session. During the alternating treatments phase, Dawn’s baseline disturbances decreased to 7.5% disturbances per session, with an average of 5% disturbance intervals per session using technology self-monitoring and 6.9% disturbance intervals per session with paper and pencil self-monitoring.

Visual analysis indicates paper and pencil may be the most stable as sessions continued,
but technology intervention reached zero instances of disruptive behavior in 3 sessions compared to only one session of 0 behavior with paper and pencil. No-treatment during alternating treatments phase indicated a possible spill-over effect. Tau-U effect size indicates Dawn had a moderate effect across all conditions and phases, with the largest effect occurring between baseline and technology, closely followed between baseline and paper-based conditions.

During the first session of technology treatment, Dawn completed her self-monitoring in 51 s, while paper and pencil completion took 81 s. Over the course of 8 sessions for each treatment, Dawn’s implementation time was 399 s total for technology and 683 s for paper and pencil. Technology provided a faster rate of implementation at an average of 35.5 s per session while supporting a higher percentage of on-task occurrences of 96% for technology compared to 93% for paper and pencil. At 20 minutes per session, the technology intervention saves 692.3 s every 6.5 hour school day. Dawn’s total number of disturbances with technology were lower at 1 disturbance per session as compared to 1.3 disturbances per session using paper and pencil.

Social Validity Results

At the conclusion of the first study, the participants completed a social validity questionnaire as well as the teacher and classroom teaching assistant to determine the usefulness and opinions between using Google Forms© technology to self-monitor versus using paper and pencil self-record. The questionnaire consisted of 14 Likert Scale questions and a section to record any comments. Table 10 displays student’s results and Table 11 displays the teacher’s results. Overall, the students reported positive feedback on using technology with neutral results on using paper and pencil self-monitoring procedures. Results for both teacher and students indicated strongly agree that (a) Google Forms© was easy to implement, (b) students prefer to use only Google Forms© to monitor their behavior, (c) the participants would like to use Google
Table 10

*Student Scores per Social Validity Questionnaire Item*

<table>
<thead>
<tr>
<th>Social validity items</th>
<th>Adam</th>
<th>Brad</th>
<th>Claire</th>
<th>Dawn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I found the use of self-monitoring beneficial to help me monitor my behavior in class.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2. I would use Google Forms© in other classes.</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>3. I liked my scores shown on my Chromebook daily.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4. The use of Google Forms© proved effective in providing a visual representation of my behavior.</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5. I prefer my scores to be private, where my teachers cannot see my scores.</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>6. Google Forms© was easy to implement.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7. Google Forms© did not result in negative side-effects for me.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>8. Google Forms© was a fun way to monitor my behavior.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>9. Google Forms© as a visual behavior support system was acceptable for me.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>10. Google Forms© as a visual behavior support system is acceptable for a variety of students.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>11. I prefer using the Paper and pencil form instead of Google Forms©.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12. I prefer using only Google Forms© in my class to help monitor my behavior.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>13. I prefer using both the Google Forms© and paper and pencil in class to monitor my behavior.</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>14. I would recommend using Google Forms© to other teachers or students in other classes</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Note.* 1 = strongly disagree; 2 = disagree; 3 = slightly disagree; 4 = slightly agree; 5 = agree; 6 = strongly agree
Table 11

*Teacher Scores per Social Validity Questionnaire Item*

<table>
<thead>
<tr>
<th>Social validity items</th>
<th>T</th>
<th>TA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I found the use of Google Forms© beneficial to help me monitor student behavior in class.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2. I would use Google Forms© in other classes.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>3. I liked scores shown on the students’ Chromebook daily</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4. The use of Google Forms© proved effective in providing a visual representation of student behavior.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>5. I prefer Google Forms© to be private, where only students see only their individual scores.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6. Google Forms© was easy to implement.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7. Google Forms© did not result in negative side-effects for students.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>8. Google Forms© was a fun way to monitor student behavior.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>9. Google Forms© as a visual behavior support system was acceptable for me.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>10. Google Forms© as a visual behavior support system was acceptable for a variety of students.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>11. I prefer using the paper and pencil forms instead of Google Forms© in the classroom.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12. I prefer using only Google Forms© in my class to help monitor my behavior.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>13. I prefer using both the Google Forms© and paper and pencil forms in class to monitor student behavior.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14. I would recommend using Google Forms© to other teachers or students in other classes.</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Note.* 1 = strongly disagree; 2 = disagree; 3 = slightly disagree; 4 = slightly agree; 5 = agree; 6 = strongly agree; T = Teacher; TA = Teaching Assistant
Forms© in other classes, and (d) Google Forms© was a fun way to implement self-monitoring. Neither teacher nor students indicated that they would like to implement both paper and technology interventions together, or had a preference if other teachers should be able to see their scores.

Comments written from the teacher indicated the use of technology allowed students who struggled to read to have the ability to use the Chromebook’s embedded text to voice software to have the self-monitoring questions read aloud to the students. Students commented they prefer to use technology as much as possible because it “is fun” and they could “pin” the Google Forms© to their bookmarks bar to reference. One student reported to self-monitoring himself at a higher rate than indicated, saying he liked to go back to Google Forms© whenever he felt like it and not just at the end of a session. By the end of the treatment sessions, students were enjoying Google Forms© more than paper and pencil, and were requesting to only use the technology self-monitoring strategy.

**Discussion**

The purpose of this study was to compare a self-recording technology-based intervention and a paper-based self-recording intervention for four middle-school students who demonstrated low levels of task engagement and high levels of disruptive behavior. On-task behavior, disruptive behavior, and amount of time required to implement each intervention were data collected to determine effectiveness and efficiency of the two interventions on percentage. The results indicated that both self-recording procedures improved student behavior. Although the technology-based intervention was slightly more effective for most students, the amount of time required to implement the technology-based intervention was clearly more efficient.

This study supports previous self-monitoring research using a paper-based or a
technology-based application. All students increased on-task and decreased disruptive behavior (Bedesem, 2012; Gulchak, 2008). It also supports findings of using technology to cue students (Cole, Marder, & McCann, 2000; Hoff & Sawka-Miller, 2006; McDougall et al., 2006) while not disrupting other students and teachers in the classroom environment.

This study extends current research by providing one device to students to cue, record, and submit their self-monitoring responses. Although Gulchak (2008) demonstrated students’ use of a mobile device to self-monitor, the students were unable to view their individualized results. This study extends the research by using a platform in which students, teacher, or any invested adult can view a student’s results on a multitude of devices. Additionally, the portability of the technology allows students and teachers to apply it to a multitude of settings.

This study also extends current research in self-monitoring by demonstrating a faster implementation procedure. Self-monitoring does not need to focus on solely academic achievement, but the time to implement different self-monitoring procedures may lend to an increase of available instructional time within the classroom. Self-monitoring with technology may lead to an increase of instructional time when technology is already part of the students’ everyday classroom materials. Technology aids such as graphing results automatically, instantly sharing of results with teachers, parents, and other parties involved, as well as being available to the student as many times as needed without interrupting the class to stop instruction and request more materials.

Using technology was more efficient than a paper and pencil based procedure. This study supports previous research on intervention efficiency results reported alongside intervention effectiveness (Cates et al., 2003; Morrison et al., 2014; Skinner, 2008; Skinner et al., 1997; Skinner, Belfiore, & Watson, 1995) to determine intervention impacts and instructional time
required to bring about change (Skinner, 2008). On-task behavior and disruptive occurrences were similar across sessions and students, but time to implement with technology was faster, ranging from 24 s to 36.4 s faster per session across students. Using the students’ 200-day instructional calendar, students save between 26 and almost 39 hours of instruction per school year.

The introduction of technology allowed students to progress through self-monitoring questions with little to no assistance from the teacher. All materials needed are already incorporated within the tools used in everyday lessons. When making a mistake with paper and pencil, two students wanted clean papers to redo the self-monitoring questions because they did not like the leftover eraser marks and wanted to change their answers. Using technology, the students had no need for extra copies, as mistakes were easily corrected with no further assistance from the teacher.

One of the self-monitoring questions, “How was I feeling today?”, was placed in each students’ form at the request of the teacher. The students utilized the “other” box throughout the study to add details of their life that may not always be present within the classroom routines. Student responses included “tired because I was up all night,” “my stomach hurts,” and “excited I get to leave early because I get to see my mom today.” This proved to be useful information that correlated with on-task and disruptive data collection. Students who felt sick that day did not verbally relay the information to the teacher, but would write it in their self-monitoring forms.

**Limitations and Future Research**

Although the primary researcher was present for all sessions of the study, students are capable of implementing these interventions independently. Utilizing technology allowed for more student control of the intervention. One student, Adam, reported he self-monitored at a
higher rate than once after a 20 min session. Adam verbally stated he liked to start class with self-monitoring himself on Google Forms© because it gave him the target behavior in which to think about during class. Adam reported he liked to revisit the Google Forms© randomly throughout class, often when he needed a break from his independent work, and then return his focus to academics. Allowing increased self-monitoring was not possible with a paper and pencil copy, since Adam often had one paper copy of his questions per session. Even offering multiple paper copies of the form, Adam denied the offer stating he did not want to lose any of the papers and did not want them cluttering his desk.

Although this study indicated positive outcomes using technology and self-monitoring, several limitations must be considered when interpreting the conclusions of this study. Limitations for this study include lack of maintenance phase, a preference phase, and possible spill-over effect. Future researchers should consider adding these components to gain a better understanding of long term effects of these treatments. Including baseline in the alternating treatments phases helped to limit spill-over effect between conditions, as well as continuing variations of treatments so similar treatments will not occur more than twice in a row. Future researchers should explore effects of functional behavior assessments in the self-monitoring questions. The function of behavior for participants of this study were attention-based. Efforts to recruit participants with alternate functions of behavior were not successful at this time, but further research should be conducted to explore alternate functions of behavior and the effectiveness of these interventions.

To facilitate generalization of behavior, future researchers may want to target students across settings, areas of disabilities, or incorporate other self-management components. One of the most notable limitations is a small sample size can limit external validity and
generalizability. Participants came from similar socioeconomic status and educational backgrounds, which can limit predictability in results of other populations in future studies. Chapter 4 includes a more thorough discussion of this study, limitations, applications, and future research.
Chapter III: Study II

Comparing the Effects of On-Task and Disruptive behavior Using a Paper-Based Self-Graphing Procedure and Technology-Based Self-Recording Graphing Procedures
Purpose

Study II. The purpose of this study was to compare the effects of using a paper-based self-graphing procedure or a technology-based self-graphing procedure on task engagement and disruptive behavior. Specific research questions include:

1. What were the effects of using a paper-based self-graphing procedure for middle school students with disabilities on task-engagement and disruptive behavior?
2. What were the effects of using a technology-based self-graphing procedure for middle school students with disabilities on task-engagement and disruptive behavior?
3. What were the differential effects of using paper-based and technology-based self-graphing procedures?
4. What do students think about using paper-based and technology-based self-graphing procedures?

Method

Setting and Participants

The special education classroom setting was the same as Study I. The student participants also were the same as Study I. However, there was an 8-month gap between the conclusion of Study I and the start of Study II. Participants did not continue to self-monitor during these eight months, and a new baseline was established prior to interventions for this study.

Materials

Materials included a paper and pencil blank graph, stopwatch, Google Forms© that allowed students to answer self-monitoring questions at the end of a task and automatically record their answers within a digital format. Google Forms© is a free application that allowed the target behavior to be customizable for each student’s specific target behavior.
Five Chromebooks were used for this study. Chromebooks were provided to all students as a 1:1 school technology initiative. All students were familiar with using digital devices for academic tasks and have used these devices across multiple classroom settings. Each student, as well as the classroom teacher, had their own Chromebook. Each Chromebook had 16GB, weighed less than a pound, had wireless access, and retails at $208 each. Preloaded on each Chromebook was the Google Forms© application, a timer application, and minimal access to other applications on the device. All students had free access to Google Drive and its components through their email provided by the school district.

**Independent Variables**

Similar to Study I, students continued to use the Chromebook and Google Forms© to self-record. However, the Google Forms© self-graphing application was enabled for the technology-based intervention condition. Students were prompted after 20 min to respond to direct behavior rating questions focused on academic engagement, disruptions, and respectful behavior using via technology-based procedures: (a) What percentage of time was I on-task? (b) How well do I understand the material from today? (c) How many times did I distract others? (d) How was I feeling today? and (e) How well did I ignore disruptions? Figure 14 is an example of the self-recording form. On-task was defined as (a) being in one’s own seat, (b) looking at materials or teacher, or (c) writing related to the assigned task and was reviewed with the students prior to intervention. Student self-monitored their behavior rating scale questions using a 0 to 10 rating scale which equated to percentages 0-100%. Students selected from multiple choice and open-ended response to answer “How was I feeling today?” and “How many times did I distract others?”
**Paper-based intervention.** During the paper-based intervention condition, students self-monitored via Google Forms© after 20 min independent work when students transitioned from independent work time to small group. Then, students were provided with graph paper and their response to “What percentage of time was I on-task?” to self-graph. Graphing was focused on this question because it lends itself to a bar graph within Google-forms and allowed consistency across intervention phases. Graph paper provided already included labeled axis. The amount of time required for students to self-monitor was recorded using a stopwatch. The teacher and teacher assistant both had two stopwatches, for a total of 4 stop watches. Each stopwatch was assigned to one participant and time started when the student began self-graphing and stopped after the graph was completed.

**Technology-based intervention.** During the Google-graphing conditions, students were given a link to the form (Figure 14) at the start of class. After 20 min, a timer prompted students to self-monitor when students transitioned from independent work time to small group. After recording, Google-forms automatically showed each of their responses in a bar graph.

The amount of time required for students to self-monitor was recorded using a stopwatch. The teacher and teacher assistant both had two stopwatches, for a total of 4 stop watches. Each stopwatch was assigned to one participant and time started when the student clicked submit and stopped after the automatic graph was produced.

**Dependent Variables and Data Collection**

The three dependent variables were: (a) percentages of intervals of on-task, (b) percentages of intervals of disruptive behavior, and (c) time required to self-graph procedures. Data were collected during the first 20 min of class when students were expected to work independently (Appendix F). Both the classroom teacher and teacher assistant collected data.
Figure 14. Google-form self-monitoring questions as viewed by student.
Each day two students were randomly assigned to be observed by the teacher and the other two students were assigned to be observed by the teacher assistant.

**On-Task.** On-task was defined as (a) being in one’s own seat, (b) looking at materials or teacher, or (c) writing related to the assigned task. Data were collected using a 10 s momentary time sampling procedures and 5 s for the observer to record the behavior. At the end of each 10 s interval, the teacher looked at two of the four students and recorded a “+” if they were on-task or a “-“ if they were not on-task. Likewise, the teacher assistant recorded data using the same procedures for the other two students. The total number of on-task occurrence intervals was then divided by the total intervals possible (i.e., 80 intervals) to calculate the percentage of on-task occurrence intervals.

**Disruptive behavior.** Disruptive behavior were defined as (a) making inappropriate noises, (b) talking without permission, and (c) gesturing inappropriately to others. Data were collected using a 10 s partial interval recording procedures and 5 s for the observer to record the behavior. The teacher observed two of the four students and recorded a “+” if they were observed demonstrating a disruptive behavior or a “-“ if they were not observed being disruptive during each 10 s interval. Likewise, teacher assistant recorded data using the same procedures for the other two students. The total number disruptive occurrence intervals was then divided by the total number of intervals possible (i.e., 80 intervals) to calculate the percentage of occurrence intervals of disruptive behavior.

**Time Required to Implement Self-Monitoring.** The amount of time required for students to self-monitor was recorded using a stopwatch. The teacher and teacher assistant both had two stopwatches, for a total of 4 stop watches. Each stopwatch was assigned to one
participant and time started when the student began self-graphing or accessed the auto-graphing feature and ended upon students viewing the completed graph.

**Design and Treatment Conditions**

An alternating treatments design (Gast, 2009) allowed the lead investigator to compare the relation between each treatment condition (i.e., paper graphing and technology graphing) and student on-task and disruptive behavior performance. Graphing treatment conditions were presented randomly to reduce potential carryover effects. Additionally, the baseline condition, no-graphing, was continued as a third condition of the alternating treatments in order to allow for the demonstration of a functional relation between the independent and dependent variables. In addition, the amount of time required during intervention implementation was collected to examine which intervention was more efficient. Interventions were randomly assigned daily, which also included a no-graphing condition that was probed weekly. The more effective graphing treatment was defined as bifurcation of the data paths or if the student or teacher reported a preference using one application over another via the social validity questionnaire.

**Procedures**

**General Classroom Procedures.** At the beginning of each class, the teacher lead a whole class lesson for approximately 10 min. Afterwards, students were expected to work independently for 20 min. During this time, student observations were recorded. Independent activities were planned for 30 min, with expectations that students worked the entire duration of data collection. If students had a question, or completed early, students were instructed to switch to individualized computer-based instruction until independent time completed. At the end of 20 min, the Chromebook timer prompted the students to self-monitor. After they self-recorded, students then graphed via paper-based procedures.
**Baseline.** During baseline, the teacher prompted the students to self-record their behavior after 20 min of independent work using Google-forms. However, the automatic graphing feature was disabled. The teacher and teacher assistant recorded student on-task and disruptive behavior and no additional feedback was provided.

**Student-Training.** Prior to baseline data collection, students reviewed previous training on the Chromebook regarding how to use the device and self-record. First, the teacher model how to use the Chromebook. Then, the teacher led the students in how to respond to the self-monitor questions. Finally, the teacher tested the student ability to independently access and use the Chromebook to self-monitor. Students were considered successfully trained if they could independently access and use the Chromebook to self-monitor for three consecutive sessions.

Additionally, students reviewed on-task and off-task behaviors using technology-based self-recording procedures. Training on self-monitoring procedures occurred for three 10 min sessions. Students were asked to identify if a behavior was “on-task” or “off-task” after hearing a teacher read classroom scenario. The teacher also modeled to the students how to complete the self-recording form (see figure 14). Students then practiced completing the form. Students were considered trained when they responded to self-recording correctly for three consecutive sessions. All students successfully differentiated between on-task and off-task classroom scenarios and completed the self-recording form correctly for three consecutive sessions.

**Technology-Based/Auto Graphing Condition.** Similar to study I, students were given a Chromebook and were prompted to turn it on and access the Google-Forms application upon entering the classroom. The Chromebook timer alerted students to record if they on-task and respond to the self-recording questions. The alert made a quiet sound or small vibration after 20
min. Students self-recorded directly on Google Forms© after 20 min to direct behavior rating
questions focused on academic engagement, disruptions, and respectful behavior using via
technology-based procedures. However, students also reviewed a bar graph that was
automatically created. Upon completion of the Google self-monitoring form, the researcher
toggled the ability for students to see an automatic graph appear or not. During the technology-
based intervention, the graphs automatically appeared to the students after completing self-
monitoring questions without any further steps taken by the students.

**Paper-Based Graphing Condition.** Similar to the technology-based intervention,
students used a Chromebook to record if they on-task and respond to the other self-recording
questions every 20 min. The Chromebook timer also was set for every 20 min. However, students
were provided with a paper-copy of their self-recorded data and prompted to graph it using graph
paper. Usual classroom procedures were applied, and the teacher recorded student on-task and
disruptive behavior, as well as time required to hand-graph. Upon completion of the self-
monitoring questions on the Chromebook, students’ hand-graphed their answer to “What
percentage of instruction did I pay attention to?” using a blank graphing paper with pre-labeled
x, y values to graph their responses.

**Analysis Procedures**

Visual analysis procedures were identical to study I to evaluate the results of automatic
graphing vs hand-graphing. To assess intervention effects, six indicators were used to examine
data patterns within-phase and between-phase including analyzing (a) trends, (b) levels, (c)
variability, (d) immediacy of effect, (e) consistency of data patterns, and (f) effect size across
phases. Within-phase comparisons were evaluated to assess predictable patterns of data, data
from adjacent phases were used to assess whether manipulation of the independent variable was
associated with change in the dependent variable, and data across all phases were used to
document a functional relation (Gast, 2009). Horner et al. (2005) states that a functional, or
causal, relation is demonstrated after at least three occurrences of an effect over a minimum of
three different points in time are observed.

Providing effect size measures allows investigators to compare these findings with other
research. Effect size was calculated with Tau-U, which is the percentage of non-overlap minus
overlap, ranging from -1 to 1 (Soloman, Howard, & Stein, 2015). Tau-U takes trend and non-
overlapping data into account, correlates with nonparametric indices, and can identify and
accommodate baseline trend if it exists (Parker et al., 2011; Vannest et al., 2016). Effect size was
calculated using a web-based application developed by Vannest and colleagues to calculate
between (a) Condition 1 and Condition 2, (b) Condition 1 and Condition 3, and (c) Condition 2
and Condition 3. Baseline treatment was combined with no-treatment conditions to account for
Condition 1. Effect size coefficients were interpreted based on Vannest and Ninci (2015)
suggested guidelines: “0.20 improvement may be considered a small change, 0.20 to 0.60 a
moderate change, 0.60 to 0.80 a large change, and above 0.80 a very large change” (p. 408).

**Inter-observer Agreement and Procedural Integrity**

Data for inter-observer agreement (IOA) were collected with a second teaching assistant
observing independently and simultaneously. The second teaching assistant was trained on data
collection procedures and familiar with this study, collecting IOA data with both the teacher and
first teaching assistant. Inter-observer reliability data were collected during a minimum 20%
sessions across baseline and alternating treatments for each student. For each session, observers
individually recorded the number of intervals for on-task behavior and disruptive behavior for
each student. For on-task behavior, the number of agreed occurrence intervals was divided by the
sum of agreed and disagreed occurrence intervals and then multiplied by 100 for each student. IOA for disruptive behavior was calculated the same as on-task behavior. IOA for seconds to self-monitor was considered in agreement if the times were within 2 seconds of each other. On-task IOA ranged from 98% to 100% (M = 99%): Adam’s IOA was 99% (M = 99%), Brad’s IOA was 100% (M = 100%), Claire’s IOA was 99% (M = 99%), and Dawn’s IOA was 98% (M = 98%). Disruptive behavior IOA ranged from 97% to 100% (M = 98.8 %): Adam’s IOA was 99% (M = 99%), Brad’s IOA was 99% (M = 99%), Claire’s IOA was 100% (M = 100%), and Dawn’s IOA was 97% (M = 98%).

Procedural integrity measures were used to determine the classroom teacher’s performance according to the prescribed procedures. The classroom teacher behavior included (a) handing students a Chromebook at the start of class, (b) providing paper graph to self-graph, (c) providing students enough time to self-monitor and (d) providing students enough time to self-graph during paper-intervention phase (Appendix E). Scores for the procedural agreement levels were calculated by dividing the number of observed teacher behavior by the number of planned teacher behavior and multiplying by 100 (Billingsley, White, & Munson, 1980). The mean procedural reliability agreement was 100% during the hand-graphing intervention, and 100% during the auto-graphing intervention with technology.

Social Validity Measure

Following the completed intervention, all 4 students, the teacher and teacher assistant who participated in this study were asked to complete a 14-item social validity questionnaire (Appendices G and H) using a Likert-type scale. The Likert scale (Likert, 1932) ranges from 1-strongly disagree to 6- strongly agree. Higher scores indicated a more acceptability. Questions addressed the ease of access, the immediate feedback available, intrusion of technology in the
classroom, and the likelihood of using the materials in the future.

**Results**

Figures 15, 18, 21, and 24 display the results of each participant's percentage of on-task occurrence intervals across phases. During baseline, all students’ on-task performance decreased for all four participants prior to the alternating treatments phase. During the alternating treatments phase, on-task improvement varied across students. Visual analysis procedures indicated an overall similarity using the hand-graphing intervention compared to the auto-graphing intervention.

Figures 16, 19, 22, and 25 display the results for each participant’s percent occurrence intervals of disruptive behavior for each intervention treatment. With the introduction of the interventions, visual analysis procedures for all participants across phases suggested the technology intervention with automatic graphing was comparable to hand-graphing for participants to reduce the occurrence of disruptive behavior.

Figures 17, 20, 23, and 26 display the results regarding how long it took each student to self-record using paper-based and technology self-recording procedures. The cumulative number of seconds of each intervention implementation is displayed. Visual analysis procedures across all participants indicated the automatic graphing was more efficient and required less time to implement than graphing by hand. Across all four participants, the technology-based intervention average 46s less time to implement per session than self-graphing with paper, which is an overall average of 6 minutes faster to implement across all eight sessions.

Table 12 provides ranges, means, and standard deviation for on-task performance across students. All four students increased their on-task performance for both interventions compared to baseline. Brad, Claire, and Dawn all demonstrated improved levels using technology self-
Figure 15. Adam’s percentage of on-task occurrence intervals across baseline and alternating treatments.

Figure 16. Adam’s Percentage of Intervals Scored Disruptive Behavior.
Figure 17. Adam’s seconds to self-monitor.

Figure 18. Brad’s percentage of on-task occurrence intervals across baseline and alternating treatments.
Figure 19. Brad’s percentage of Intervals Scored Disruptive Behavior.

Figure 20. Brad’s seconds to self-graph.
Figure 21. Claire’s percentage of on-task occurrence intervals across baseline and alternating treatments.

Figure 22. Claire’s percentage of Intervals Scored Disruptive Behavior.
Figure 23. Claire’s seconds to self-monitor.

Figure 24. Dawn’s percentage of on-task occurrence intervals across baseline and alternating treatments.
Figure 25. Dawn’s Percentage of Intervals Scored Disruptive Behavior.

Figure 26. Dawn’s seconds to self-monitor.
graphing procedures compared to paper and pencil self-graphing. Adam was the only student whose averages improved slightly more with paper and pencil procedures than technology procedures. All students returned near baseline levels during the alternating treatment baseline condition.

Table 13 provides effects sizes across conditions as measured by Tau-U for on-task performances across all 4 students. Effect size was “large” or “very large” comparing baseline to paper and pencil treatment, as well as comparing baseline to technology treatment. Paper and pencil compared to technology resulted in a “small” effect on on-task performance for Adam, a “large” effect for Claire, and a “moderate” effect for Dawn. Brad was the only student to have “very large” effect sizes across all conditions and phases.

Table 12

*Average On-Task Performance for Baseline and Intervention Phases*

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Paper/Pencil</th>
<th>Technology</th>
<th>Alternating Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
</tr>
<tr>
<td>Adam</td>
<td>71.0% (2.2)</td>
<td>87.5% (6.5)</td>
<td>86.3% (5.8)</td>
<td>76.3% (2.5)</td>
</tr>
<tr>
<td></td>
<td>70%-75%</td>
<td>80%-95%</td>
<td>80%-95%</td>
<td>75%-80%</td>
</tr>
<tr>
<td>Brad</td>
<td>60.0% (5.0)</td>
<td>85.6% (3.2)</td>
<td>95.0% (3.8)</td>
<td>55.0% (4.1)</td>
</tr>
<tr>
<td></td>
<td>55%-65%</td>
<td>80%-90%</td>
<td>90%-100%</td>
<td>50%-60%</td>
</tr>
<tr>
<td>Claire</td>
<td>59.0% (4.2)</td>
<td>70.6% (4.2)</td>
<td>78.1% (5.9)</td>
<td>63.8% (4.8)</td>
</tr>
<tr>
<td></td>
<td>55%-65%</td>
<td>65%-75%</td>
<td>65%-85%</td>
<td>60%-70%</td>
</tr>
<tr>
<td>Dawn</td>
<td>68.0% (2.7)</td>
<td>96.9% (2.6)</td>
<td>98.1% (2.6)</td>
<td>78.8% (7.5)</td>
</tr>
<tr>
<td></td>
<td>65%-70%</td>
<td>95%-100%</td>
<td>95%-100%</td>
<td>70%-85%</td>
</tr>
</tbody>
</table>
Table 13

* Tau-U Effect size On-Task Performance across Conditions and Phases *

<table>
<thead>
<tr>
<th>Comparisons</th>
<th>Baseline-Paper/Pencil</th>
<th>Baseline-Technology</th>
<th>Paper/Pencil-Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>0.75 (Large)</td>
<td>0.74 (Large)</td>
<td>0.13 (Small)</td>
</tr>
<tr>
<td>Brad</td>
<td>1.00 (Very Large)</td>
<td>1.00 (Very Large)</td>
<td>0.94 (Very Large)</td>
</tr>
<tr>
<td>Claire</td>
<td>0.60 (Large)</td>
<td>0.69 (Large)</td>
<td>0.73 (Large)</td>
</tr>
<tr>
<td>Dawn</td>
<td>0.61 (Large)</td>
<td>0.61 (Large)</td>
<td>0.25 (Moderate)</td>
</tr>
</tbody>
</table>

Table 14 provides ranges, means, and standard deviation for behavior performance across students. Intervals scored disruptive behavior decreased for all students utilizing either intervention compared to baseline. Brad, Claire, and Dawn improved slightly more with technology procedures than paper and pencil procedures. Adam was an exception, who maintained the same average with both treatment conditions. All students’ behavior returned near baseline levels during the no-treatment conditions within alternating treatments phase.

Table 15 provides effects sizes for behavior performance across conditions as measured by Tau-U. Baseline compared to paper and pencil treatment resulted in a “moderate” effect size for three students (Adam, Brad, and Dawn), with a “large” effect size for Claire. Technology treatment condition indicated a “very large” effect size for Brad and Claire, and “moderate” effect sizes for Adam and Dawn when compared to baseline. When both intervention treatments were compared to each other, Tau-U results indicated a “moderate” or “small” effect for all students favoring technology.
Table 14

Average Behavior Performance for Baseline and Intervention Phases

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Paper/Pencil</th>
<th>Technology</th>
<th>Alternating Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
</tr>
<tr>
<td>Adam</td>
<td>12.0% (2.7)</td>
<td>8.8% (2.3)</td>
<td>8.8% (3.5)</td>
<td>11.3% (2.5)</td>
</tr>
<tr>
<td></td>
<td>10%-15%</td>
<td>5%-10%</td>
<td>5%-15%</td>
<td>10%-15%</td>
</tr>
<tr>
<td>Brad</td>
<td>21.0% (2.2)</td>
<td>13.8% (8.8)</td>
<td>6.3% (4.4)</td>
<td>21.3% (2.5)</td>
</tr>
<tr>
<td></td>
<td>20%-25%</td>
<td>5%-25%</td>
<td>0%-10%</td>
<td>20%-25%</td>
</tr>
<tr>
<td>Claire</td>
<td>48.0% (7.6)</td>
<td>35.0% (8.9)</td>
<td>28.8% (5.2)</td>
<td>48.8% (2.5)</td>
</tr>
<tr>
<td></td>
<td>40%-55%</td>
<td>25%-45%</td>
<td>20%-35%</td>
<td>45%-50%</td>
</tr>
<tr>
<td>Dawn</td>
<td>15.0% (3.5)</td>
<td>5.6% (3.2)</td>
<td>4.4% (4.2)</td>
<td>8.8% (4.8)</td>
</tr>
<tr>
<td></td>
<td>10%-20%</td>
<td>0%-10%</td>
<td>0%-10%</td>
<td>5%-15%</td>
</tr>
</tbody>
</table>

Table 15

Tau-U Effect size Behavior Performance across Conditions and Phases

<table>
<thead>
<tr>
<th>Comparisons</th>
<th>Baseline-Hand-graphing</th>
<th>Baseline-Auto-graphing</th>
<th>Hand-graphing-Auto-graphing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>0.50 (Moderate)</td>
<td>0.46 (Moderate)</td>
<td>0.03 (Small)</td>
</tr>
<tr>
<td>Brad</td>
<td>0.46 (Moderate)</td>
<td>1.00 (Very Large)</td>
<td>0.47 (Moderate)</td>
</tr>
<tr>
<td>Claire</td>
<td>0.79 (Large)</td>
<td>1.00 (Very Large)</td>
<td>0.38 (Moderate)</td>
</tr>
<tr>
<td>Dawn</td>
<td>0.42 (Moderate)</td>
<td>0.47 (Moderate)</td>
<td>0.19 (Small)</td>
</tr>
</tbody>
</table>
Adam. Figure 15 displays Adam’s results of on-task performance. During baseline, Adam’s on-task performance averaged 71% occurrence intervals and he demonstrated consistent last three data points at 70%. During the hand-graph intervention, Adam’s on-task behavior immediately improved to an average of 87.5% occurrence intervals. During the auto-graph intervention, Adam’s on-task behavior also immediately improved to an average of 86.3% occurrence intervals. No-intervention phase indicated a decrease performance to an average of 76.3% on-task intervals.

Both intervention treatments demonstrated an immediate increase to on-task performance intervals at or above 80%. Paper and pencil procedures reached 100% on-task first, however data was varied as the study continued. Technology treatment conditions indicated a rising trend, reaching 100% on-task intervals while paper and pencil conditions had dropped to 80% on-task intervals. Tau-U effect size indicates “large” effects with either self-graphing procedure, and a “small” effect between the self-graphing procedures.

Figure 16 displays Adam’s results for percent occurrence intervals of disruptive behavior across baseline and alternative treatment phases. Adam displayed 10% to 15% disruptive behavior per session during baseline and average 12% occurrence intervals of disruptive behavior. During the hand-graph intervention, Adam’s disruptive behavior decreased to 8.8%. During the auto-graph intervention, Adam’s disruptive behavior also decreased to 8.8% occurrence intervals of disruptive behavior. Adam’s disruptive behavior continued to perform at high levels with no intervention as indicated by 11.3% disruptive occurrences during baseline within alternating treatments phase.

Tau-U results indicate effect sizes as “moderate” between baseline and both technology and paper and pencil phases. Both intervention treatments maintained low percentages of
intervals scored disruptive behavior, which could be attributed to low baseline percentages at the start of the study.

Figure 17 displays the amount of time required to implement both interventions for Adam. The hand-graph intervention required a total of 512 s for the 8 intervention sessions, whereas 116 across the 8 intervention sessions was required for the technology-based intervention. The technology-based intervention provided a more efficient rate of implementation with an average of 49.5 s per session while resulting in similar on-task performance. At 20 min per session, the technology intervention saves 965.3 s every 6.5 hour school day.

**Brad.** Figure 18 displays Brad’s percentage of on-task occurrences with a baseline of 60% on-task ranging from 55% to 65% and a downward trend before implementing alternating treatments. During the alternating treatments phase, Brad’s percentage of on-task occurrences rose to an average of 85.6% with hand-graphing and 95% on-task with automatic graphing strategies. Both treatments continued to be more effective than baseline no-intervention phase, which maintained an average of 55% on-task occurrences.

Both treatments led to an immediate jump to 90% on-task occurrence intervals, with data bifurcated with auto-graphing treatment conditions rising to 100% on-task occurrence intervals. Hand-graphing treatment conditions resulted at a stable 80%. Both treatment conditions resulted in “very large” effect sizes compared to baseline, and “very large” effect size when comparing each treatment condition.

Figure 19 displays Brad’s results of percent occurrence intervals of disruptive behavior. During baseline, Brad had range of behavior from 20% to 25% disruptive occurrences intervals during baseline. Brad averaged 21.0% disturbances per session in baseline which increased to
21.3% average occurrence intervals of disturbances per session during baseline no-intervention phase. With the use of auto-graphing, Brad decreased his average percent of disruptive behavior to 6.3% per session, while hand-graphing intervention showed Brad’s percentage of disruptive occurrences decreasing to an average of 13.8% per session.

Visual analysis of Brad’s data shows a trend of disturbances decreasing with both hand-graphing and auto-graphing while baseline accounts for larger variability of disturbances. Auto-graphing resulted in immediate decrease of scored disruptive behavior intervals and a decreasing trend to reach 0% twice throughout the study. Hand-graphing began at baseline levels and continued a downward trend through the study. Tau-U effect size indicated a “very large” effect comparing auto-graphing with baseline but only a “moderate” effect comparing hand-graphing with baseline.

Figure 20 displays Brad’s cumulative implementation time of interventions. During the first session of auto-graphing treatment, Brad completed his self-monitoring in 22 s, while hand-graphing took 48 s. Over the course of 8 sessions for each treatment, Brad’s implementation time was 162 s total for auto-graphing and 387 s for graphing by hand. Technology provided a faster rate of implementation at an average of 28.1 s per session while supporting a higher percentage of on-task occurrences of 95% for auto-graphing compared to 85.6% for hand-graphing, as well as 14.7% lower percentage of disruptive behavior compared to baseline no-intervention phase when using automatic graphing. At 20 min per session, the technology intervention saves 548 s every 6.5 hour school day.

**Claire.** Figure 21 displays Claire’s results of on-task percentages. During baseline, Claire had a variable trend of on-task occurrences that averaged 59% across 5 sessions. During the baseline no-treatment phase, on-task performance increased to an average of 63.8%. Claire’s on-
task percentage to 70.6% with the use of hand-graphing, and 78.1% with the use of automatic graphing self-monitoring strategies.

Visual analysis indicated an upward trend with hand-graphing treatment starting at baseline levels and rising near 80% on-task occurrence intervals throughout the study. Auto-graphing treatment conditions showed immediate effect near 80% and maintained the scores through the study. Tau-U effect size took into consideration a rising no-intervention treatment condition to demonstrate a “large” effect for both interventions.

Figure 22 displays Claire’s results of percent occurrence intervals of disruptive behavior, with baseline data ranging from 40% to 55% occurrence intervals. Claire averaged 48.0% disturbances per session in baseline which remained equivalent to 48.8% average disturbances per session during baseline no-intervention phase. With the use of auto-graphing, Claire decreased her average percent of disruptive behavior to 28.8% per session, while hand-graphing intervention showed Claire’s disruptive occurrences decreasing to an average of 35.0% per session.

Results indicated baseline levels with an increasing trend, and continuing a stable baseline no-intervention treatment near 50% scored disruptive behavior. An immediate effect was shown with auto-graphing treatment conditions, resulting in a stable trend ending near 20% scored disrupting behavior. Hand-graphing treatment conditions began near baseline levels with a downward trend near the end of the study. Calculated effect sizes show a “large” effect with hand-graphing procedures and a “very large” effect utilizing auto-graphing procedures.

Figure 23 displays the results of Claire’s cumulative seconds of implementation time. During the first session of auto-graphing treatment, Claire completed her self-monitoring in 18 s, while hand-graphing took 72 s. Over the course of 8 sessions for each treatment, Claire’s
implementation time was 166 s total for auto-graphing and 585 s for graphing by hand. Auto-
graphing provided a faster rate of implementation at an average of 52.4 s per session while
supporting a higher percentage of on-task occurrences of 78% for auto-graphing compared to
70.6% for hand-graphing intervention. At 20 min per session, the technology intervention saves
1,021.8 s every 6.5 hour school day. Claire’s total percentage of disturbances with auto-graphing
were lower at 28.8% disturbances per session as compared to 35% disturbances per session using
hand-graphing procedures, indicating technology procedures were more effective.

Dawn. Figure 24 displays Dawn’s percentage of on-task occurrences with a baseline of
68.0% on-task ranging from 65% to 70% and a stable trend before implementing alternating
treatments. During the alternating treatments phase, Dawn’s percentage of on-task occurrences
rose to an average of 96.9% with hand-graphing procedures and 98.1% on-task with auto-
graphing procedures. Dawn’s baseline no-intervention phase increased to an average of 78.8%
on-task occurrences, indicating a possible carryover effect.

Results indicated an immediate increase to above 95% on-task occurrence intervals for
both intervention conditions. Data were stable throughout the study, with multiple instances of
100% on-task occurrence intervals within both intervention conditions. No-intervention
treatment condition also rose to 80%. Taking an increase baseline effect into account, Tau-U
effect sizes indicate “large” effects for both auto-graphing and hand-graphing procedures.

Figure 25 displays the results of Dawn’s percent occurrence intervals of disruptive
behavior across sessions. During baseline, Dawn’s average percentage of disruptive behavior
were 15.0% per session. During the alternating treatments phase, Dawn’s baseline no-treatment
disturbances decreased to 8.8% occurrence intervals of disturbances per session, with 5.6%
occurrence intervals of disturbance per session using hand-graphing procedures and 4.4%
occurrence intervals of disturbances per session with automatic graphing procedures.

Results indicate both graphing by hand and auto-graphing as equivalent effectiveness, with baseline indicating a downward trend as both treatments continue. An immediate effect for both intervention procedures was noted. However Dawn began the study with baseline levels at or below 20% so effect sizes were “moderate” comparing either intervention to baseline. A “small” effect size was noted preferring auto-graphing procedures over hand-graphing procedures due to 3 consecutive data points reaching 0% faster than hand-graphing procedures.

Figure 26 displays the results of Dawn’s cumulative seconds of implementation time. During the first session of auto-graphing treatment, Dawn completed her self-monitoring in 48 s, while hand-graphing completion took 90 s. Over the course of 8 sessions for each treatment, Dawn’s implementation time was 349 s total for auto-graphing and 762 s for graphing by hand. Auto-graphing provided a faster rate of implementation at an average of 51.6 s per session while supporting a higher percentage of on-task occurrences of 98% for auto-graphing compared to 96.9% for hand-graphing. At 20 min per session, the technology intervention saves 1,006.2 s every 6.5 hour school day. Dawn’s total percentage of disturbances with auto-graphing were lower at 4.4% per session as compared to 5.6% disturbances per session using hand-graphing procedures, indicating technology procedures were more effective.

Social Validity Results

At the conclusion of the study, the participants completed a social validity questionnaire as well as the teacher to determine the usefulness and opinions between using Google Forms© technology to auto-graph versus graphing by hand. The questionnaire consisted of 14 Likert Scale questions and a section to record any comments. Table 16 displays student’s results and table 17 displays the teacher’s results. Overall, the students reported positive feedback on using
Table 16

*Student scores per social validity questionnaire item.*

<table>
<thead>
<tr>
<th>Social validity items</th>
<th>Adam</th>
<th>Brad</th>
<th>Claire</th>
<th>Dawn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I found the use of graphing beneficial to help me monitor my behavior in class.</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>2. I would use Graphing in Google Forms© in other classes.</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>3. I liked my scores automatically shown in a graph on Google Forms© once I completed the self-monitoring form.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4. The use of graphing in Google Forms© proved effective in providing a visual representation of my behavior.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>5. I prefer my graphs to be private, where my teachers cannot see my scores.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6. Graphing with Google Form was easy to implement.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7. Graphing on Google Forms© did not result in negative side-effects for me.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>8. Graphing on Google Forms© was a fun way to monitor my behavior.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>9. Graphing with Google Forms© as a visual behavior support system was acceptable for me.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>10. Google Forms© graphing as a visual behavior support system is acceptable for a variety of students.</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>11. I prefer graphing my results by hand instead of automatic graphing on Google Forms©.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12. I prefer using only Google Forms© in my class to graph my results</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>13. I prefer using both the Google Forms© Graphing and graph by hand.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14. I would recommend using Graphing in Google Forms© to other teachers or students in other classes.</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Note.* 1 = strongly disagree; 2 = disagree; 3 = slightly disagree; 4 = slightly agree; 5 = agree; 6 = strongly agree
Table 17

*Teacher scores per social validity questionnaire item.*

<table>
<thead>
<tr>
<th>Social validity items</th>
<th>T</th>
<th>TA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I found the use of Graphing on Google Forms© beneficial to help me monitor student behavior in class.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2. I would use Graphing in Google Forms© in other classes.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>3. I liked student scores to automatically show in a graph on Google Forms© once students completed the self-monitoring form</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4. The use of graphing in Google Forms© proved effective in providing a visual representation of student behavior.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>5. I prefer Graphing on Google Forms© to be private, where students see only their individual scores.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6. Graphing on Google Forms© was easy to implement.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7. Graphing with Google Forms© did not result in negative side-effects for students.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>8. Graphing on Google Forms© was a fun way to monitor student behavior.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>9. Graphing on Google Forms© as a visual behavior support system was acceptable for me.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>10. Graphing on Google Forms© as a visual behavior support system was acceptable for a variety of students.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>11. I prefer using hand-graphing instead of automatic graphing on Google Forms© in the classroom.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12. I prefer using only Google Forms© in my class to graph student results.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>13. I prefer using both the automatic graphing on Google Forms© and hand-graphing in class to monitor student behavior.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14. I would recommend using graphing with Google Forms© to other teachers or students in other classes.</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Note.* 1 = strongly disagree; 2 = disagree; 3 = slightly disagree; 4 = slightly agree; 5 = agree; 6 = strongly agree; T = Teacher; TA = Teaching Assistant
automatic graphing components of Google Forms© compared to graphing by hand, which received negative feedback. Results for both teacher and students indicated strongly agree that (a) Google Forms© was easy to implement, (b) students prefer to use only Google Forms© to monitor their behavior, (c) the participants would like to use Google Forms© in other classes, and (d) Google Forms© was a fun way to implement self-monitoring. Neither teacher nor students indicated that they would like to implement both paper and technology interventions together, or had a preference on if other teachers should be able to see their scores.

Comments written from the teacher indicated the use of technology allowed students who struggled to read to have the ability to use the Chromebook’s embedded text to voice software to have the self-monitoring questions read aloud to the students. Students commented they prefer to use technology as much as possible because it “is fun” and they could “pin” the Google Forms© to their bookmarks bar to reference. One student even admitted to self-monitoring himself at a higher rate than indicated, saying he liked to go back to Google Forms© whenever he felt like it and not just at the end of a session. By the end of the treatment sessions, students were enjoying Google Forms© more than paper and pencil, and were requesting to only use the technology self-monitoring strategy.

**Discussion**

The purpose of this study was to add a second component, self-graphing, to the preferential self-monitoring strategy of technology as determined in Study I, and determine whether graphing by paper and pencil or automatic technology graphing was more effective in increasing on-task behavior and decreasing disruptive behavior. Moreover, data were collected to determine the efficiency of implementation compared to the effects of both interventions.

This study supports previous research that found that utilizing technology with self-
monitoring is effective for students with disabilities (Bedesem, 2012; Blood et al., 2011; Gulchak, 2008; Palermo, Valenzuela, & Stork, 2004). This study supports previous research on intervention efficiency reported alongside intervention effectiveness (Cates et al., 2003; Morrison et al., 2014; Skinner, 2008; Skinner et al., 1997; Skinner, Belfiore, & Watson, 1995) to determine intervention impacts and instructional time required to bring about change (Skinner, 2008). Students’ on-task behavior increased and disruptive occurrences decreased similarly across both interventions, but time to implement with technology was faster, ranging from 28.1 seconds to 52.4 seconds faster per session across students. Using the students’ 200 day instructional calendar, students save between 30 and 56 hours of instruction per school year by utilizing automatic graphing on technology instead of graphing by hand if students were to use this intervention on a daily basis across all of their classes.

This study extends current research by utilizing technology to self-monitor and initiate occasions for students to self-evaluate with automatic graphing. Brad and Claire showed a preference for automatic graphing for on-task, with little variability in disruptive behavior between the interventions. Adam and Dawn increased on-task engagement and decreased disruptive behavior without much variability between the two methods of intervention. However, technology was preferred and accounted for an increase of instruction time returned to the teacher.

Automatic graphing with technology may occasion self-evaluation by focusing the student’s attention of the results and bypassing the process of physically graphing, which often became frustrating and perceived as tedious by the students. Students were observed spending more time actually making the graph rather than analyzing the graph. Students often spent extra time regarding the “neatness” of their graphs and would ask for additional paper to make “better
looking” graphs.

Nelson (1977) suggested that the process alone may result in behavior change due to reactivity. Environmental cues, antecedents, recording device, and reactivity from others may influence response frequency (Nelson & Hayes, 1981; Rachlin, 1974). Students were observed to view the automatic graphs and comment to their peers about their results, often comparing results across students. Comments during this time were recorded as “Man, you need to focus more!” and “well, why did you talk so much then?” which harnessed the results of the functional behavior assessments of the students indicating peer attention as a function of behavior. While it is difficult to determine if students did self-evaluate, the automatic graphing component occasions the opportunity to self-evaluate independently, with peers, or share with parents and teachers.

Previous research indicated self-evaluation allows the student to receive immediate feedback towards their goals (Johnson, Graham, & Harris, 1997) with trends that are easy to distinguish and visual analysis of results may occur. Within the review of literature, only 10% of studies included a self-evaluation component, of which none completed self-evaluation utilizing technology. By graphing behavior and providing a visual analysis, some students may be motivated to track their goals, increasing motivation to continue to change behavior.

Limitations and Future Research

Although this study indicated positive outcomes using technology and self-monitoring, several limitations must be considered when interpreting the conclusions of this study. Limitations for this study include lack of maintenance phase and a preference phase. Future researchers should consider adding these components to gain a better understanding of long term effects of these treatments. Possible spill-over effects are also a concern, however including
baseline in the alternating treatments phases and continuing variations of treatments so similar treatments will not occur more than twice in a row limited spill-over effect between conditions. Another limitation was the types of graphs available to students. With Google Forms©, many questions allowed for a pie-chart graph that updated with each response across sessions, which prevented a display of progress across time. The students did not have prior instruction on how to make a pie chart, nor was it conducive to update a pie chart daily as it led to creating a new pie chart for each session. Only one question was used to graph by hand, which lent itself to a bar graph within Google Forms© and could easily be replicated on paper by hand. With Google Forms©, all questions had a visual response and self-evaluation was not limited to one question. With technology-based graphing condition, students received more feedback because a graph produced for all questions.

The results of this study extend the research that self-monitoring components such as self-graphing can enhance student on-task behavior and decrease disruptive behavior, yet with the use of technology, the results can be similar, socially preferred by students and teachers, with much faster implementation time. This allows for higher rates of feedback, less instruction lost during the day, and opportunities to self-evaluate. To facilitate generalization of behavior, future researchers may want to target students across settings, areas of disabilities, or incorporate other self-management components. One of the most notable limitations is that a small sample size (n = 4) can limit external validity and generalizability. Participants came from similar socioeconomic status and educational backgrounds, which can limit predictability in results of other populations in future studies. Chapter 4 includes a more thorough discussion of this study, limitations, applications, and future research.
Chapter IV:

Conclusion and General Discussion
This dissertation was composed of two studies that replicated and extended the research literature on evaluating the effectiveness of self-monitoring strategies utilizing technology for students with disabilities. Additionally, the researcher investigated a self-graphing component with technology component not previously researched and social validity measures favored technology.

Study I compared a paper and pencil intervention to a technology-based intervention on disruptive and on-task behavior while reporting the amount of time required to implement each intervention. Study II extended Study I by using technology as a self-graphing component. Data were collected on on-task behavior, disruptive occurrences, and time of implementation. Results demonstrated that technology interventions provided functionally equivalent or better outcomes than paper-based interventions. The amount of time to implement the technology-based intervention was faster and more efficient. When extrapolated across a 200-day school year, a range of 26 to 40 hours of extra instruction time is returned to the teacher using this technology intervention.

Results of Study I and Study II indicated a clear separation between baseline data and on-task behavior, suggesting a functional relation between on-task behavior and self-monitoring data across all four students. Kratochwill et. al. (2010) stated “…these designs often involve repeated, systematic measurement of a dependent variable before, during, and after the active manipulation of an independent variable (e.g., applying an intervention). SCDs can provide a strong basis for establishing causal inference, and these designs are widely used in applied and clinical disciplines in psychology and education, such as school psychology and the field of special education.” (p. 2). Results of these studies demonstrate an immediate effect on on-task behavior once the interventions were implemented compared to both baseline and no-intervention phases.

Effect size measured by Tau-U indicated technology interventions had an equal or better
impact on on-task engagement. Tau-U results indicated “large” or “very large” effect sizes for student on-task behavior. Tau-U results included more “moderate” effects between baseline and intervention phases for disruptive behavior. Both studies, including all four students, demonstrated that the time to implement technology was more efficient than paper and pencil while maintaining similar results. Despite the difference in implementation time, technology self-monitoring interventions resulted in an equal or better impact with on-task engagement and disruptive behavior.

**Previous and Extension of the Research**

Single-subject methodologies are effective at exploring new interventions in a variety of settings to demonstrate changes in target behavior individualized to the student and the environment (Horner et al., 2005). Both studies support previous research that technology is more likely to be used to reliably monitor student behavior progress versus paper and pencil interventions (Palermo, Valenzuela, & Stork, 2003). While previous studies have found that utilizing technology with self-monitoring is effective for students with disabilities (Bedesem, 2012; Blood et al., 2011; Gulchak, 2008), technology as the primary and sole platform to self-evaluate has not been researched. Blood et al. (2011) used video modeling prior to self-monitoring to teach students how to identify and record on-task and disruptive behavior. Although student behavior improved, technology was used more as an instructional strategy rather than a means to record and monitor behavior. In this study, the use of technology to both record and graph their behavior on one device is an extension from previous studies.

In this study, the use of technology to self-graph offered students automatic feedback and increased student occasions to self-evaluate. Technology offered immediate feedback and reduced time students used to hand-graph, which may occasion students to self-evaluate target
behaviors. Previous studies reporting self-graphing have only occurred with paper-based procedures or other individuals graphing for the student. Bedesem (2012) used text messages on a cell phone to cue students to record their own responses, yet teachers were using the responses to evaluate, instead of students evaluating themselves. Gulchak (2008) reported successful findings of a student with EBD using technology to self-record, but technology was only used to self-record. The student did not self-evaluate. The studies in this dissertation provided students one device to cue, record, and graph their self-monitoring responses.

Both studies extend previous research by increasing the efficiency of using self-monitoring by integrating technology into all self-monitoring components. Focusing only on intervention effectiveness in research could yield misleading results (Skinner, 2008). Intervention effectiveness is not sufficient for understanding the impact of an intervention; intervention efficiency needs to be considered to produce the greatest growth in the shortest amount of time (Cates et al., 2003; Morrison et al., 2014; Skinner, 2008; Skinner et al., 1997; Skinner, Belfiore, & Watson, 1995). Results of these studies indicated students required more time to implement graphing by hand as compared to an automatic graph of results using technology. On-task behavior and disruptive occurrences were similar across sessions and students, but time to implement with technology was faster, ranging from 36.4 s to 51.6 s faster per session across students. Using the students’ 200-day instructional calendar, students save between 30 and almost 56 hours of instruction per school year by utilizing automatic graphing on technology instead of graphing by hand, as long as students were to use this intervention on a daily basis across all of their classes.

Social validity results also should be considered to determine the social significance of target behaviors (Babbie, 1995; Baer et al., 1968). Interviews, opinion surveys, or questionnaires
with the direct participants provide critical information about the social significance, opinions, perceptions, and feelings of an intervention (Wolf, 1978). Students and teachers’ social validity results agree with efficiency of intervention and indicated a preference for technology. Results also indicated all four students agreed or strongly agreed that they (a) found self-monitoring to help monitor behavior in class, (b) students enjoyed seeing responses on their Chromebook, (c) they would use Google Forms© in other classes, (d) Google Forms© was easy to implement with no negative side effects and (e) using technology was fun and acceptable for a variety of students. The open-ended questions from the social validity survey indicated participants do not prefer paper and pencil copies if given a choice.

Results from the social validity survey determined all students preferred technology-based procedures. Adam stated he self-monitored at a higher rate than instructed, due to the ease of access to the self-monitoring intervention. Implementing self-monitoring procedures on a Chromebook would allow student access to self-monitoring questions in every class due to their access to technology in every educational setting.

Students and teachers indicated preference for the technology-based intervention. Adam reported he self-monitored at a higher rate than once after a 20 min session. Adam verbally stated he liked to start class independently with self-monitoring on Google Forms© because it gave him personalized target behaviors to think about during class. Adam reported he liked to revisit the Google Forms© platform randomly throughout class, often when he needed a break from his independent work, and then return his focus to academics.

**Applications**

There are a several notable applications to be considered when using a technology-based intervention in the classroom. Applications for both studies included implementation efficiency
of using technology to gain more instructional time, accessibility to materials in the general education classroom, and generalization of skills to the work setting. With the use of 1:1 technology in the school system, all students used their Chromebooks in all classes. Chromebooks allow for minimal loss of instruction time, students’ preferred use of device, and increased access to self-monitoring across general education settings and between stakeholders. With the introduction of technology-based intervention, students demonstrated an equal or better behavior change as with the paper and pencil version yet was more efficient with minimal loss in instructional time. When extrapolated across a 200-day school year, a range of 26 to 40 hours of extra instruction time is returned to the teacher using technology intervention strategies.

Accessibility to materials can include students generalizing self-monitoring applications to other classes. Sharing results with all other stakeholders is a component that can be enabled with Google Forms©. Collaboration between stakeholders may increase occasions to evaluate with a stakeholder to increase reactivity (DiGangi et al., 1991). The individual stakeholder may be a teacher, coach, parent, or anyone who can access Google on any device without needing the specific device the student used to record. Data collected by the students is updated in real time, and results are viewable immediately. Parents at home, teachers in the next class, or a coach after school can view student responses and behavior and reinforce positive behaviors upon evaluation.

Technology-based interventions teach technology skills which can be generalized to be successful in the working environment. Technology-based systems from computers, phones, game systems, and appliances are creating an interconnected system of tools for people, which can offer people with disabilities assistance, support, and allows students to participate in the social and economic life (Domingo, 2012).
Limitations

With all research, limitations must be considered when interpreting the findings. First, students were familiar and had a history of using technology to self-record. Students participated in both studies although 8 months of no interventions were in effect between the conclusion of Study I and the start of Study II. Baseline for students in Study II returned to similar baseline levels as seen in Study I. Returning to baseline between interventions suggests ongoing systematic instruction and fading is needed (Gast, 2010).

A second noteworthy limitation includes possible multi-treatment interference from rapidly alternating interventions across sessions and creating a spillover effect (Gast, 2010). Baseline maintained stability or a downward trend in alternating treatments phase compared to baseline condition phase in on-task phases in both studies across all students. Dawn’s on-task behavior in Study II showed increasing yet not overlapping data within intervention treatments. Baseline in treatment conditions may have had a spillover effect on all students and their disruptive behavior in both studies. Exceptions include Dawn in Study I whose baselines during interventions were higher yet stable, and Brad and Claire in Study II whose baselines remained stable throughout the intervention phase. However, spillover effect between conditions in both studies was limited by including a no-intervention probes during the alternating treatments phases, as well as randomization of treatment implementation so similar treatments did not occur more than twice in a row.

A third limitation with this study was lack of the ability to graph select responses to an individual’s target behavior. Criteria on which question was chosen for students to self-graph was based on the ease of graphing responses and not based on an individual’s target behavior. With the introduction of automatic graphs in Study II, students were able to access a visual for
every question, which may occasion self-evaluation across questions and target behaviors. This study was limited because it only supported hand-graphing for one response, which lent itself to a bar graph. During the technology intervention, students were provided a visual graph summary for each question answered. Feedback from participants in Study II included the preference for a pie chart visual, which made it easy for students to analyze the impact of their responses to their overall progress. One student wrote “The pie chart changes as I respond. I don’t like watching the bar graph change, it is boring.” By graphing behavior for all questions and providing a visual analysis, some students may be motivated to watch their goals be slowly, yet surely obtained as they work toward them, thereby increasing motivation to continue to change target behavior.

Since different charts and graphs were not evaluated in this study, future research should extend preferences for different graphs to determine the impact of this variability on student achievement of their target behavior.

An inherit limitation of all single-case design studies to consider is a small sample size which can limit external validity and generalizability (Gast, 2010). Participants were from similar socioeconomic status and educational backgrounds, which can limit predictability in results of other populations in future studies. Furthermore, using an alternating treatments design precludes the use of a maintenance phase and a preference phase (Gast, 2010). Limitations for both studies included a lack of preferred treatment phase due to the majority support for technology in social validity questionnaires and verbal responses of students asking if they can just use technology instead of needing to do paper and pencil. Future researchers should consider adding these components to their designs to gain a better understanding of long-term effects of these treatments.
Future Research

Future research should replicate and extend these studies. Future research is needed to study the effects of technology to self-monitor and auto-graph. Graphing by hand may increase response opportunities (Bloom et al., 1992) and enhance behavioral and academic interventions when paired with a self-graphing component (DiGangi, Maag, & Rutherford, 1991; Gunter et al., 2002). More research is needed to determine the extent to which technology provides immediate feedback and occasion student self-evaluation across ability levels, ages, skills, and behavior.

Future research should investigate the importance of digital literacy skills such as prerequisite computer skills or use of Google Forms© ease of use among various ability levels, ages, and behaviors. All participants in these studies were familiar with technology uses in their everyday lives and use technology on a daily basis in the forms of cell phones and Chromebook computers. Individuals are required to use technical, sociological, and cognitive skills to perform tasks in digital environments (Gilster, 1997; Norton & Wiburg, 1998). Future research should investigate which skills are a prerequisite for an intervention using Google Forms© in a classroom setting.

Future research should consider functional-based behavior. Function-based behavior is not a widely considered aspect of self-monitoring. In 2013, Hansen et al. suggested self-management interventions’ effects can be enhanced when incorporating a functional-based assessment. The intervention may itself be enough for a student to set a goal and never need to observe or record their behavior again based solely on their awareness that they exhibited that behavior. Others, however, seek out the reinforcements of tangibles or attention from others. This intervention provided the opportunity for the student to gain access to their individualized reinforcers. While students commenting on other students’ results was common, data collection
on peer to peer feedback did not occur. Research suggests using a variety of components, such as self-evaluation, self-reinforcement, or self-instruction, in combination with self-monitoring. However, it may be important to further research the role of function based self-monitoring and addressing those functions through self-reinforcement or other components to meet student behavioral needs. Despite efforts to recruit participants with alternate functions of behavior beyond the attention seeking participants in these studies, further research should include function-based questions to individual students to determine the impact of function-related questions on individual student behavior.

Future research also should evaluate systematic fading procedures to limit behavior reversing or examining students’ needing more time using the interventions. These studies provided set cues after 20 min intervals, which may be what the participants required, so students should be taught how and when to monitor themselves with an individualized cue. Adam made it known that he self-monitored at a higher rate than others with technology, but it is unclear whether others did the same.

Researchers should evaluate whether these procedures generalize to general education classrooms and other populations. The social validity questionnaire (Tables 10 and 16) indicated slight agreement to strong agreement for students to use technology-procedures in other classes to help monitor their behavior. To facilitate generalization of behavior, future researchers may want to target students across settings and areas of disability, and incorporate other self-management components using technology.

Implications

Teachers spend a lot amount of instructional time managing student behavior, often using reactive strategies which correlate to a decrease in students’ task engagement (Clunies-Ross,
Little, & Kienhuis, 2008). High frequency, low-intensity, disruptive, and off-task behavior is considered especially problematic because of a loss of instructional time and negative impacts upon the learning process (Aloe, AMo, & Shanahan, 2014; Sullivan et al., 2014). Rather than viewing cell phones and electronic devices as a distraction in classroom, teachers should view technology as a powerful learning tool that can be used to place students in control of their own behavior (Luchini, Quintana, & Soloway, 2004). More schools are ensuring each student receives their own device. Students are expected to be literate using technology and teachers are expected to incorporate technology in their lessons. Technology is moving away from new and disruptive and should be viewed as a mobile learning environment that moves with the learner (Ogato & Yano, 2004).

Self-management interventions lend themselves to behavior change that may result in generalization across time and settings (Holman & Baer, 1979). Teachers and students need to use technology. Students who progress through the curriculum at different rates than their peers may use this intervention with a targeted behavior focus unique to specific classes. Use of Google Forms© creates student independence as it consists of student-led self-recording and occasions self-evaluation without teacher intervention to provide feedback in order for students to evaluate themselves. Professional development for technology is still necessary for all stakeholders to address concerns about digital literacy and how to provide feedback to the students with a new self-monitoring platform (Desimoine, et al., 2002; Schrum, 1999).

Although self-monitoring is a highly researched practice (Reid, 1996), technology use has lagged behind. Technology is improving the effectiveness of how we can implement research strategies. Self-monitoring has been widely used in special education to support students in being successful in the classroom (Briesch & Daniels, 2013; Graham-Day, Gardner, & Hsin, 2010;
Hoff & Sawka-Miller, 2010; Holman & Baer, 1979; Mace, Belfiore, & Hutchinson, 2001; Maag, 2004; Moore et al., 2013; Rafferty, 2010). It is vital to provide students with skills and strategies that can help them monitor their own behavior or academics and reach a self-administered, perhaps self-designed, goal.

This two-companion study dissertation demonstrated the positive impact of using technology to improve on-task performance. Technology is ever changing with greater applications for students with disabilities. Educational technologies are continuously developing, and empirically examining the utility of technology to meet the needs of all students in a 21st century classroom is imperative.
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https://doi.org/10.1177/074193259301400206


Appendices
### Appendix A. Data Collection Form Study I.

**Student__________________ Observer______________________**

Date__________

<table>
<thead>
<tr>
<th>Minute 1</th>
<th>Min 2</th>
<th>Min 3</th>
<th>Min 4</th>
<th>Min 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**on-task ( +/- )**

tally: disruptions

<table>
<thead>
<tr>
<th>Min6</th>
<th>Min 7</th>
<th>Min 8</th>
<th>Min 9</th>
<th>Min 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

**on-task ( +/- )**

tally: disruptions

<table>
<thead>
<tr>
<th>Min 11</th>
<th>Min 12</th>
<th>Min 13</th>
<th>Min 14</th>
<th>Min 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
</tr>
</tbody>
</table>

**on-task ( +/- )**

tally: disruptions

<table>
<thead>
<tr>
<th>Min 16</th>
<th>Min 17</th>
<th>Min 18</th>
<th>Min 19</th>
<th>Min 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
</tr>
</tbody>
</table>

**on-task ( +/- )**

tally: disruptions

**Duration of Self-Graphing Seconds:**

124
Appendix B. Procedural Reliability Data Sheet. Study I.

Date________ Start Time________ Stop Time_________ Observer________________

<table>
<thead>
<tr>
<th>Task</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data collection occurs first 20 min of class</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Interval recording occurs every 30 seconds</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Disruptive behavior recorded every 30 seconds</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students accessed Google Forms©</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students accessed Paper/Pencil Form</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students prompted to Self-monitor</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students complete every question</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Duration of implementation began when students began self-monitoring and ended after self-monitoring was complete</td>
<td>Y / N / NA</td>
</tr>
</tbody>
</table>

TOTAL: _____________________/___________________ = ____________%
Appendix C. Student Social Validity Worksheet. Study I.
Student questionnaire about the use of Google Forms© during Classroom Instruction. The purpose of this questionnaire is to obtain information regarding the use Google Forms© during classroom instruction.

Please circle the number which best describes your agreement or disagreement with each statement.

<table>
<thead>
<tr>
<th>Teacher: __________________________</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I found the use of self-monitoring beneficial to help me monitor my behavior in class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2. I would use Google Forms© in other classes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>3. I liked my scores shown on my Chromebook daily.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4. The use of Google Forms© proved effective in providing a visual representation of my behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>5. I prefer my scores to be private, where my teachers cannot see my scores.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6. Google Forms© was easy to implement.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7. Google Forms© did not result in negative side-effects for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>8. Google Forms© was a fun way to monitor my behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>9. Google Forms© as a visual behavior support system was acceptable for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>10. Google Forms© as a visual behavior support system is acceptable for a variety of students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Statement</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>11. I prefer using the Paper and pencil form instead of Google Forms©.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I prefer using only Google Forms© in my class to help monitor my behavior.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. I prefer using both the Google Forms© and paper and pencil in class to monitor my behavior.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. I would recommend using Google Forms© to other teachers or students in other classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
**Appendix D. Teacher Social Validity Worksheet. Study I.**

Teacher questionnaire about the use of Google Forms© during testing and assessment situations. The purpose of this questionnaire is to obtain information regarding the use of Google Forms© during testing situations. Please circle the number which best describes your agreement or disagreement with each statement.

<table>
<thead>
<tr>
<th>Teacher: ___________________________</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>School: ____________________________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I found the use of Google Forms© beneficial to help me monitor student behavior in class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2. I would use Google Forms© in other classes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>3. I liked scores shown on the students’ Chromebook daily</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4. The use of Google Forms© proved effective in providing a visual representation of student behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>5. I prefer Google Forms© to be private, where only students see only their individual scores.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6. Google Forms© was easy to implement.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7. Google Forms© did not result in negative side-effects for students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>8. Google Forms© was a fun way to monitor student behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>9. Google Forms© as a visual behavior support system was acceptable for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>10. Google Forms© as a visual behavior support system was acceptable for a variety of students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>
11. I prefer using the paper and pencil forms instead of Google Forms® in the classroom.  

12. I prefer using only Google Forms® in my class to help monitor student behavior.  

13. I prefer using both the Google Forms® and paper and pencil forms in class to monitor student behavior.  

14. I would recommend using Google Forms® to other teachers or students in other classes.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. I prefer using the paper and pencil forms instead of Google Forms® in the classroom.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12. I prefer using only Google Forms® in my class to help monitor student behavior.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>13. I prefer using both the Google Forms® and paper and pencil forms in class to monitor student behavior.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. I would recommend using Google Forms® to other teachers or students in other classes.</td>
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</tr>
</tbody>
</table>

Comments:
### Appendix E. Data Collection Form Study II.

**Student__________________________**  
**Observer__________________________**  
**Date______________________________**

<table>
<thead>
<tr>
<th></th>
<th>Minute 1</th>
<th>Minute 2</th>
<th>Minute 3</th>
<th>Minute 4</th>
<th>Minute 5</th>
<th>Minute 6</th>
<th>Minute 7</th>
<th>Minute 8</th>
<th>Minute 9</th>
<th>Minute 10</th>
<th>Minute 11</th>
<th>Minute 12</th>
<th>Minute 13</th>
<th>Minute 14</th>
<th>Minute 15</th>
<th>Minute 16</th>
</tr>
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<tr>
<th>Minute 17</th>
<th>Minute 18</th>
<th>Minute 19</th>
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</tbody>
</table>

on-task ( +/- )

tally: disruptions

Duration of Seconds
Self-Graphing:
### Appendix F. Procedural Reliability Data Sheet. Study II.

<table>
<thead>
<tr>
<th>Task</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data collection occurs first 20 min of class</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Interval recording occurs every 15 seconds</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Disruptive behavior recorded every 15 seconds</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students accessed Google Forms©</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students accessed graphing paper</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students prompted to Self-monitor</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Students complete every question</td>
<td>Y / N / NA</td>
</tr>
<tr>
<td>Duration of implementation began when students began self-monitoring and ended after graphing was complete</td>
<td>Y / N / NA</td>
</tr>
</tbody>
</table>
Appendix G. Student Social Validity Worksheet. Study II.

Student questionnaire about the use of Google Forms© during Classroom Instruction. The purpose of this questionnaire is to obtain information regarding the use Google Forms© during classroom instruction.

Please circle the number which best describes your agreement or disagreement with each statement.

<table>
<thead>
<tr>
<th>Teacher:__________________________</th>
<th>School:___________________________</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I found the use of graphing to help me monitor my behavior in class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2. I would use Graphing in Google Forms© in other classes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>3. I liked my scores automatically shown in a Graph on Google Forms© once I completed the self-monitoring form.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>4. The use of graphing in Google Forms© proved effective in providing a visual representation of my behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5. I prefer my graphs to be private, where my teachers cannot see my scores.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>6. Graphing in Google Forms© was easy to implement.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7. Graphing on Google Forms© did not result in negative side-effects for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>8. Graphing on Google Forms© was a fun way to monitor my behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
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</tr>
<tr>
<td>9. Graphing with Google Forms© as a visual behavior support system was acceptable for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>10. Google Forms© graphing as a visual behavior support system is acceptable for a variety of students.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>11. I prefer graphing my results by hand instead of automatic graphing on Google Forms©.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
<td>6</td>
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<tr>
<td>12. I prefer using only Google Forms© in my class to graph my results.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
<td>6</td>
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<tr>
<td>13. I prefer using both the Google Forms© Graphing and graphing by hand</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>14. I would recommend using Graphing in Google Forms© to other teachers or students in other classes.</td>
<td>1</td>
<td>2</td>
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</tr>
</tbody>
</table>

Comments:
Appendix H. Teacher Social Validity Worksheet. Study II.

Teacher questionnaire about the use of Google Forms© during testing and assessment situations. The purpose of this questionnaire is to obtain information regarding the use of Google Forms© during testing situations. Please circle the number which best describes your agreement or disagreement with each statement.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I found the use of Graphing on Google Forms© beneficial to help me monitor student behavior in class.</td>
<td></td>
<td>1</td>
<td>2</td>
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<tr>
<td>2. I would use Graphing in Google Forms© in other classes.</td>
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<tr>
<td>3. I liked student scores to automatically show in a graph on Google Forms© once students completed the self-monitoring form.</td>
<td></td>
<td>1</td>
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<tr>
<td>4. The use of graphing in Google Forms© proved effective in providing a visual representation of student behavior.</td>
<td></td>
<td>1</td>
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<tr>
<td>5. I prefer graphing in Google Forms© to be private, where only students see only their individual scores.</td>
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<td>1</td>
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<td>6. Graphing in Google Forms© was easy to implement.</td>
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<tr>
<td>7. Graphing on Google Forms© did not result in negative side-effects for students.</td>
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<tr>
<td>11.</td>
<td>I prefer using hand-graphing instead of automatic graphing on Google Forms© in the classroom.</td>
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<td>12.</td>
<td>I prefer using only Google Forms© in my class to graph student results.</td>
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<td>13.</td>
<td>I prefer using both the Google Forms© and hand-graphing in class to monitor student behavior.</td>
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Comments:
Appendix I. Approved IRB Consent

December 08, 2016

Laura A Mahany,
UTK - Theory & Practice In Teacher Education

Re: UTK IRB-16-03226-XP

Study Title: What are the effects of a digital self-monitoring application on task engagement and problem behaviors for middle school students with attention seeking behaviors?

Dear Laura A Mahany:

The UTK Institutional Review Board (IRB) reviewed your application for the above referenced project. It determined that your application is eligible for expedited review under 45 CFR 46.110(b)(1), categories (5) and (7). The use of children as subjects is approved under 45 CFR 46.504, in that it involves no more than minimal risk. The IRB has reviewed these materials and determined that they do comply with proper consideration for the rights and welfare of human subjects and the regulatory requirements for the protection of human subjects.

Therefore, this letter constitutes full approval by the IRB of your application (version 1.4) as submitted, including Nov 22 teacher informed consent (v.1.0), Nov 22 parent informed consent (v. 1.1), Nov 22 student assent form (v.1.1), Fidelity Checklist Google Forms (v.1.0), Student and Teacher Questionnaire (v. 1.0), Self-Monitoring Sheet (v.1.0), partial interval recording sheet (v.1.0), and Demographic Data (v.1.0). The listed documents have been dated and stamped IRB approved. Approval of this study will be valid from December 08, 2016 to December 7, 2017.

In the event that subjects are to be recruited using solicitation materials, such as brochures, posters, web-based advertisements, etc., these materials must receive prior approval of the IRB. Any revisions in the approved application must also be submitted to and approved by the IRB prior to implementation. In addition, you are responsible for reporting any unanticipated serious adverse events or other problems involving risks to subjects or others in the manner required by the local IRB policy.

Finally, re-approval of your project is required by the IRB in accord with the conditions specified above. You may not continue the research study beyond the time or other limits specified unless you obtain prior written approval of the IRB.

Sincerely,

Colleen P. Gilmore, Ph.D.
Chair

Institutional Review Board (Office of Research & Engagement)
1334 White Avenue
Knoxville, TN 37996-1329
865-974-7697 865-974-7699 fax irb@utk.edu

BIG ORANGE, BIG IDEAS.
Vita

Laura Mahany was born in Arkport, New York. She graduated from Arkport Central School in 2004 and then began attending the State University of New York at Fredonia. In 2008, she graduated from SUNY Fredonia with a B.S. in Education, Childhood Inclusive Education, and Chemistry. Laura earned her M.S. in Integrating Technology in the Classroom from Walden University in 2012. While working full time as a middle school special education teacher at Knox County Schools, Laura pursued her PhD in special education at the University of Tennessee. Laura will graduate with a PhD in Special Education from the University of Tennessee in December 2018.