ABSTRACT

EFFECTS OF SELF-MONITORING DURING INQUIRY BASED LEARNING ON THE BEHAVIOR AND ACADEMIC PERFORMANCE OF AT-RISK MIDDLE SCHOOL STUDENTS

by Jessie Watkins

Research indicates that inquiry-based instruction is an effective teaching strategy; however, at-risk students may need supports in this type of instruction in order to be successful. This study examined the effect of using a self-monitoring intervention during an inquiry-based science unit on the on-task behavior, disruptive behavior and academic achievement of at-risk middle school students. Students who were enrolled in an eighth grade alternative program participated in this study; however, observational data was only collected for two students. A mixed methods approach was used that embedded a multiple baseline across participants design and a pre/posttest design. The results indicated that the self-monitoring intervention increased both student’s on-task behavior and one student showed a significant decrease in disruptive behavior. The student’s academic achievement also indirectly increased.
EFFECTS OF SELF-MONITORING DURING INQUIRY BASED LEARNING ON THE BEHAVIOR AND ACADEMIC PERFORMANCE OF AT-RISK MIDDLE SCHOOL STUDENTS

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Introduction

School dropout is problematic for individuals in the United States due to the high prevalence and economic and individual consequences encountered in society (Christenson & Thrulow, 2004; Christle, Jolivette & Nelson, 2007). The Alliance for Excellent Education reports that there are about 1.2 or more million drop-outs per year (Amos, 2008). In addition, middle school students have an increased risk of drop out because of the increase in personal changes and decisions they are faced with (Wood, Murdock & Cronin, 2002). Research continues to investigate strategies to support these struggling learners and to ultimately decrease the dropout rate. One highly effective strategy that has an expansive research base is self-monitoring. Self-monitoring can be used with a variety of different needs such as academic and behavioral needs (Menzies & Bruhn, 2010). It involves a student being taught the desired behavior and then the student monitors and records this behavior (Bruhn & Watt, 2012).

The current study investigates the use of this strategy and its relationship to multiple behaviors often related to drop out. It is important to examine ways to decrease the risk for these students in order for them to graduate and become successful. Furthermore, as classroom instructional practices begin to shift from textbook driven learning to more inquiry-based approaches, it is important that effective practices are researched that will support both the learning and behavioral needs of struggling students in these settings (Therrien, Taylor, Watt, & Kaldenberg, 2013). This is because inquiry-based learning has been found to be most effective when there are structured supports in place (Therrien, Taylor, Hosp, Kaldenberg & Gorsh, 2011). Students may struggle during inquiry-based instruction when there is a lack of teacher direction because they have not yet acquired the skills needed to be successful without direction or feedback (Klahr & Nigam, 2004). It may also be more difficult because the decrease in teacher direction could cause students to become off-task (Therrien et al., 2013). Therefore, it is important to incorporate structural supports in inquiry-based instruction for struggling students. The main purpose of this study was to assess the effectiveness of a self-monitoring intervention in providing support to help struggling students become successful in an inquiry-based science unit.
Literature Review

Characteristics of At-risk Students

At-risk students are students that are vulnerable to school drop-out (Sagor & Cox, 2004). There are three major predictors of school drop-out: low socioeconomic status, school suspensions, and low academic success (Suh, S., Suh, J. & Houston, 2007). Approximately eighty percent of the at-risk student population are discouraged and unmotivated (Sagor & Cox, 2004). They may be discouraged because they are academically behind their peers. As discouraged learners, at-risk students often have low self-confidence, dislike school, become wary of adults and do not plan for their future (Sagor & Cox, 2004). Students can also be considered at risk if they experience difficulties such as physical disabilities, poverty, abuse and family drug dependency (Sagor & Cox, 2004). Additional common characteristics include frequent absences, poor and disruptive behavior in the classroom, and negative attitudes (Sagor & Cox, 2004).

Inquiry-based Instruction

The continuation of improving classroom instruction, especially regarding science instruction, has lead researchers to try new and different approaches. Inquiry-based instruction is an approach that many teachers and professionals have been encouraged to use in order to help students comprehend aspects of scientific theories (Minner, Levy & Century, 2009). Therefore, this approach has seen increased use in the schools, which has improved the quality of science instruction (Watt, Therrien, Kaldenberg & Taylor, 2013). An inquiry-based science instruction research synthesis by Minner and colleagues (2009) found that a large number of studies examining inquiry instruction found a positive impact on student’s content retention ($n=71, 51\%$) and 33% of the studies showed a mixed impact. Inquiry-based instruction was shaped from the learning theory, constructivism (Minner, et al., 2009). This theory is based on the idea that learning is constructed through social interactions and active engagement (Piaget, 1972; Minner, et al., 2009). Inquiry-based instruction is a student-centered approach to learning that allows students to develop scientific meaning through discovery, negotiation, and experimentation. Throughout inquiry-based learning, students are participating in activities rather than a lecture-based class; however, the main component of inquiry-based learning is that students are discovering learning themselves (Therrien et al., 2013)
There are three major aspects of inquiry-based instruction. The first is having students participate in scientific activities such as conducting experiments and using the scientific method; the second is having students learn through active thinking and questioning and the third is allowing students to extend upon their knowledge (Minner, et al., 2009). Teachers may use this approach on a continuum of pure discovery to structured inquiry (Watt, et al., 2013). Pure discovery involves having students determine the problem and set up the investigation without any feedback (Watt, et al., 2013). During structured inquiry the teacher frames the problem and investigation, provides feedback and includes other supports such as graphic organizers (Watt, et al., 2013). Pure discovery environments may not provide students with appropriate feedback or practice and it may make it difficult for students to make appropriate mental connections (Khlar & Nigam, 2004). Structured inquiry-based instruction is a systematic process that allows students to organize information and make connections while investigating and negotiating science (Watt et al., 2013). Therefore, pure discovery in an inquiry setting, along with some supports, is an ideal mixture of practices (Watt et al., 2013).

**Self-monitoring**

Self-monitoring is a management system used to help students learn to monitor their own behavior. This will allow students to not have to solely rely on teacher guidance, which would be valuable for student independence and would allow teachers to address other issues in the classroom (McDougall, Morrison & Awana, 2012). Self-monitoring should be used as a secondary prevention strategy, when the first prevention strategy did not make an impact on the student’s academic skills; about 10-15 % of students are predicted to need secondary supports, while 3- 5% may need even more individualized supports (Menzies & Bruhn, 2010). Self-monitoring has been identified as one of the most common self-management strategies used with students (Mooney, Ryan, Uhing, Reid & Epstein, 2005).

In order to be effective, self-monitoring must have a clear, operational definition of target behaviors for the students involved to observe and record (Menzies & Bruhn, 2010). This is because the student needs to clearly know what they are monitoring in order to effectively monitor their behavior (Vanderbilt, 2005). The most common target behaviors that are examined in research include on-task behavior, disruptive behavior and academic behavior. These three
behaviors are important factors of being successful in school. Findings show that self-monitoring can positively affect these behaviors.

For example, Rafferty, Arroyo, Ginnane and Wilczynski (2011) examined the effect of a self-monitoring strategy with on-task behavior for fifth grade students diagnosed with ADHD. The students self-monitored during an independent spelling practice period where they also used a six-step spelling study strategy. The students would record tally marks on a T-chart if they were paying attention when a tone sounded through headphones. The mean percentage of on-task behavior for the three target participants was 47%, 52% and 38%. These percentages increased to 85%, 88% and 80% after the intervention. On-task behavior was measured through the primary and secondary researcher’s observations. Student spelling accuracy also increased for each target participant.

Research has examined tactile methods of cueing students to monitor their on-task behaviors. This strategy is less distracting than audio cues or teacher prompts if there are other students in the room that are not participating in the intervention. Amato-Zech, Hoff and Doepke (2006) and Rafferty (2012) used the MotivAider, a vibrating electronic device that the students wore on their waistbands or kept in their pockets. The MotivAider is a commonly used device that was also used to monitor academic productivity and task completion by McDougall and colleagues (2012). Both Amato-Zech (2006) and colleagues and Rafferty (2012) also used a version of the same mnemonic device to teach the students on and off-task behaviors. The results for both of these studies showed an increase in on-task behavior for all participants, which supports the monitoring of on-task behaviors using tactile cues.

Research has also examined electronic methods other than tactile cues from electronic devices like the MotivAider with on-task behavior. Blood, Johnson, Ridenour, Simmons and Crouch (2011) used an iPod touch for self-modeling and self-monitoring of on-task behaviors for one student. The student would watch videos of himself to learn to recognize his on and off-task behaviors. He also used the iPod touch as a timer that signaled when he should self-record his behavior on a sheet of paper. When self-modeling and self-monitoring was combined there was a consistent increase in behavior but there was inconsistency in results when video-modeling was used alone.

Disruptive behaviors can have an impact on a student’s academic performance (Nelson, Benner, Lane & Smith, 2004). These behaviors impact the student that is exhibiting the
behaviors and it could also distract the other students in the room (Blood et al., 2011). Bruhn and Watt (2012) examined disruptive behavior for students with or at-risk for emotional or behavior disorders. Their study examined the impact of a multi-component self-monitoring procedure on the academic engagement and disruptive behavior for two middle school girls with reading and behavioral issues. The two students rated their behavior on classroom expectations at the end of each activity rotation. Their results suggest that a self-monitoring intervention can be used to decrease disruptive behaviors and increase academic engagement.

Other research has also examined the impact of a self-monitoring intervention on disruptive behavior. Quillivan, Skinner, Hawthorn, White and Ballard (2011) implemented a self-monitoring strategy with a male kindergarten student that was referred for behavioral issues and also portrayed many disruptive and off-task behaviors. The self-monitoring intervention included the student monitoring his off-task behavior by circling pictures of cartoon dogs that portrayed on-task and off-task behaviors. The cartoon pictures were used to attain the attention of the young student. The student was not instructed to monitor disruptive behavior because the teachers did not want to draw attention to these behaviors. The results showed a decrease in off-task and disruptive behaviors. By monitoring on-task behavior, the student was able to also address and decrease the disruptive behaviors that seemed to put him off-task in the first place.

The majority of research that targets academic behavior, has the students monitor some form of on-task behavior in efforts that academic behavior will increase as a result. For example, Rafferty (2012) examined spelling accuracy in a study where the students self-monitored their on-task behavior. The results from this study supported the idea that self-monitoring of behavior can positively impact academics because spelling accuracy increased from monitoring on-task behavior. Holifield, Goodman, Hazelkorn and Heflin (2010) also examined academic accuracy in a study that self-monitored attending to task. Academic accuracy in this study was determined by the percentage of correct answers or assignments in language arts and math classes. These results also positively impacted the students’ academic accuracy.

Academic productivity is also an academic behavior that has been studied. McDougall and colleagues (2012) examined academic behavior by measuring academic productivity in two different studies. One study measured the percentage of steps for correct algebra problems and another measured the number of minutes to complete the task. The self-monitoring interventions
in these studies monitored on-task behavior and found significant increases in academic productivity as a result of the intervention.

Another way to target academic behaviors using a self-monitoring procedure is to have students’ monitor their academic work. Harris and colleagues (2005) had a student record the correct number of times they practiced their spelling words at the end of class. The student then graphed the information. Additional studies have also found that academic production increases when students monitor their academic work. Soares, Vannest and Harrison (2009) found that when a student with autism recorded when he finished a task, his task completion increased along with a decrease in disruptive behavior.

**Feedback and Reinforcement**

Research has shown that adult feedback or reinforcement has improved results of self-monitoring interventions (Freeman & Dexter-Mazza, 2004). During self-monitoring, feedback has been given on the student’s ability to rate themselves accurately or on their actual behavior. Matching is one method of providing feedback during self-monitoring interventions. During matching, the student and adult both monitor the student’s behavior and the adult provides feedback and reinforcement on the student’s monitoring (Freeman & Dexter-Mazza, 2004).

Freeman and Dexter-Mazza (2004) compared a self-monitoring intervention and a self-monitoring intervention with matching for a 13-year old male enrolled in special education classes at a residential facility for students with conduct issues. During the self-monitoring intervention, the student recorded if he was off-task or disruptive between beeps played through a pair of headphones. The procedure was the same during the self-monitoring with matching phase but the aid also observed the participant’s behavior. Every fifteen minutes the aide would provide feedback regarding their agreement and the participant was rewarded with a small piece of candy for having an 80% agreement with the aide. The results showed that off-task and disruptive behaviors decreased significantly more during the self-monitoring with matching phase than during self-monitoring alone or during baseline conditions.

Bruhn and Watt (2012) also incorporated feedback and reinforcement into their study. The teachers immediately provided praise or corrective feedback for meeting the expectations. Along with students rating themselves at the end of each activity, the teacher also rated the students’ behavior at the end of class. The students were rewarded for receiving 80% of the
possible points. Some of the rewards included a positive note home to parents, a front of the lunch line pass and a free homework pass. As stated previously, this study had positive results for disruptive behavior and on-task behavior.

**Generalization**

Generalization is defined as a target behavior occurring in a different setting (Miltenberger, 2011). Generalization of behavior or use of an intervention has been used in studies that examine self-monitoring. Peterson, Young, Salzberg, West and Hill (2006) collected information on generalization of a self-management strategy in transferring on and off-task behavior, along with four classroom social skills. Training occurred in a classroom for students enrolled in a program that addressed at-risk students and social issues. Students used the self-management strategy in the training classroom and in general education classes. Once the student’s data was consistent in one general education class, they used the strategy in an additional class. Data was collected through observations and the results showed increased on-task behaviors and appropriate social skills outside of the training setting for four out of the five participants. One of the participants did not show a significant change in behavior in all settings outside of the training setting, but did show some change.

Amato-Zech and colleagues (2006) also examined generalization of a self-monitoring intervention. Generalization was examined during the students’ math class. During the intervention, a vibrating device was used to prompt the students to monitor their behavior. However, this was not used during the generalization phase. On-task behavior for each participant increased from baseline phase to the generalization phase.

**Effectiveness of Self-Monitoring with At-Risk Students**

A total of 7 studies examined self-monitoring with at-risk students. See table 1 for an overview of these results.

Table 1

*Summary of Studies on Self-monitoring for At-Risk Students*

<table>
<thead>
<tr>
<th>Article</th>
<th>Sample</th>
<th>Grade/ Age</th>
<th>Target Behavior</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Grade</th>
<th>Meeting teachers expectations</th>
<th>Students behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peterson et al., 1999</td>
<td>29 students</td>
<td>7th and 8th</td>
<td>Teachers reached expectations in 96% of classes</td>
<td></td>
</tr>
<tr>
<td>Mitchem, Young, West &amp; Benyo, 2001</td>
<td>10 students</td>
<td>7th</td>
<td>On-task behavior, following instructions and gaining teacher attention appropriately</td>
<td>Target students on-task behavior increased from 35% to 80% and following directions and properly gaining attention also increased</td>
</tr>
<tr>
<td>Peterson et al. 2006</td>
<td>5 students</td>
<td>7th and 8th</td>
<td>On and off-task behavior and 4 classroom social skills (following directions, complying to being told no, accepting feedback and properly attaining teacher attention)</td>
<td>Students increased social skills use and decreased off-task behavior</td>
</tr>
<tr>
<td>Wood et al. 1998</td>
<td>4 students</td>
<td>Middle school</td>
<td>On-task behavior and academic</td>
<td>On-task behaviors</td>
</tr>
</tbody>
</table>
Wood, Murdock, Cronin, Dawson and Kirby (1998) examined the effects of self-monitoring on increasing on-task behaviors for at-risk students. The study also examined an indirect effect on academic performance. The students monitored their on-task behavior at the end of each class and the teachers recorded their academic performance daily. Self-monitoring performance improved for each student and academic performance gradually improved for each student.

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Grade Level</th>
<th>Academic Performance</th>
<th>Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood, Murdock &amp; Cronin, 2002</td>
<td>4 students</td>
<td>Middle school</td>
<td>Academic performance (on-task behavior and grades)</td>
<td>Improved for all 4 students</td>
</tr>
<tr>
<td>Briere &amp; Simonsen, 2011</td>
<td>2 students</td>
<td>7th and 8th grade</td>
<td>Appropriate peer interactions and on-task behavior</td>
<td>50% reduction in off-task behavior</td>
</tr>
<tr>
<td>Hoff &amp; Ervin, 2013</td>
<td>3 students</td>
<td>5th grade</td>
<td>Disruptive behavior of 3 different classes and 3 different students</td>
<td>Decreased</td>
</tr>
</tbody>
</table>

Wood, Murdock, Cronin, Dawson and Kirby (1998) examined the effects of self-monitoring on increasing on-task behaviors for at-risk students. The study also examined an indirect effect on academic performance. The students monitored their on-task behavior at the end of each class and the teachers recorded their academic performance daily. Self-monitoring
was used in three different classes and results showed an immediate increase in on-task behavior in each class. Academic behavior gradually increased in each class.

The purpose of the Wood and colleagues (2002) study was to expand upon the results of the previous study by Wood and colleagues (1998). This study examined if self-monitoring would improve academic performance when including the monitoring of grades and also examining maintenance and generalization. Therefore, Wood and colleagues (2002) defined academic performance as academic behavior and grades. Academic behavior was monitored by recording on-task behaviors such as following directions on the self-monitoring sheet. The students monitored their grades by recording them on the sheet. The results showed that all four students showed an increase in academic performance. Therefore, the findings of this study showed that self-monitoring is an effective intervention for students that are at-risk because it can improve their academic performance.

Briere and Simonson (2011) also examined on-task behavior. They examined self-monitoring of relevant and nonrelevant replacement behaviors. First a functional behavioral assessment was completed for both participants to identify the problem behavior and examine students’ off-task behaviors. Then the students self-monitored a functionally relevant target behavior and a nonrelevant target behavior. Results showed that both students off-task behavior was lower when self-monitoring the relevant target behavior. This study supports the importance of identifying and addressing specific target behaviors that are relevant to the student.

Peterson, L., Young, West and Peterson, M., (1999) examined a self-management procedure that was intended to create generalization of class behavior and social skills in other settings. The participants were enrolled in a program (Prevention Plus) that addressed anti-social skills for at-risk students. This self-management procedure included self-monitoring and teacher matching. The students were trained in the self-monitoring procedure and social skills in one setting and once certain qualifications were met, they used the procedure in other classrooms. The students monitored if they met their teacher expectations. This procedure seemed to be effective for at-risk students. The results showed that students reached teachers expectations for 96% of their classes as a whole. This was the goal of the study and it shows that self-monitoring can help at-risk students maintain classroom expectations. Peterson and colleagues (2006) was an extension of a study by Peterson and colleagues in 1999. The only difference was that the
Peterson and colleagues (2006) study measured social skills and off-task behavior. The results showed an increase in appropriate social skills and a decrease in off-task behavior. One participant did not show as much of a significant change compared to other students, however, this intervention was still considered effective.

Mitchem, Young, West and Benyo (2001) and Hoff and Ervin (2013) examined self-monitoring interventions for behavior change using a class wide approach. Mitchem and colleagues (2001) included a peer assisted component in the intervention and examined how the intervention impacted student’s on-task behavior. Hoff and Ervin (2013) had students rate their own behavior and the class’s behavior. Both studies examined how the intervention affected the behavior in individual students that were at-risk and found positive results.

Summary

In conclusion, the results of the studies including self-monitoring strategies suggest that the intervention can support at-risk students’ management of target behaviors such as on-task behavior, disruptive behavior and academic achievement. When feedback and reinforcement were used in these studies, positive results were shown. Results also indicated that self-monitoring can promote a generalization of responses into other settings. Although self-monitoring strategies among at-risk students have been documented being used during spelling, math, writing and reading, to the researcher’s knowledge, there is no study to date on self-monitoring interventions during an inquiry-based science unit. Furthermore, Wood and colleagues (2002) stated that research needs to continue to study self-monitoring of academic performance in order to gain research from a variety of different settings. The same study also stated that generalization and maintenance of self-monitoring with at-risk students needs to continue to be studied because of the lack of self-monitoring studies with at-risk students.

As discussed previously, it is ideal to combine inquiry-based instruction with structured supports for students. Results collected from a meta-analysis conducted by Therrien and colleagues (2013) indicated that at-risk students need some sort of structured support in order to be successful during inquiry-based instruction. It is unknown what types of support these students will benefit from. There is a need for research in this area. Therefore, the main goal of this study is to examine one strategy that could be effective at providing support for students during inquiry-based learning. According to Therrien and colleagues (2013), students will most
likely benefit from behavioral supports that keep students actively engaged. For this reason, this study examined a self-monitoring intervention. The intervention included on-task behavior because keeping students actively engaged is an important factor in academic success and research has indicated that self-monitoring can increase on-task behavior. In addition, student’s also monitored their disruptive behavior because it can affect a student’s learning experience and also has been shown to decrease when students self-monitor. When a student is disruptive they may miss information provided in class, get into trouble or distract other students. As a result of the intervention, academic achievement should increase because students monitored behaviors that often interfere with academic achievement.

First, the study investigated the effectiveness of a self-monitoring intervention that included feedback and reinforcement for at-risk students during an inquiry-based science unit. The self-monitoring intervention included on-task behaviors that should occur during inquiry-based learning and disruptive behaviors that should not. Second, the study examined the generalization of this intervention into another setting. Specifically, this study examined the following research questions: (1) what is the effect of a self-monitoring procedure on the on-task behavior, disruptive behavior and academic achievement of at-risk middle school students in an inquiry-based science unit? (2) what is the effect of generalizing the intervention into one other setting?

Methods

Participants and Setting

Students who were enrolled in the eighth grade alternative program were invited to participate in this study. The students in this program were identified as at-risk for school dropout, struggled both academically and behaviorally, and showed a two year discrepancy in performance based on district assessments. This program is a self-contained program that instructs the students in English Language Arts (ELA) and also supports students in content area learning. All students in the classroom were engaged in the intervention. Observational data was only collected for two students that were recommended by the teacher for having off-task and disruptive behavior. The two students included Ben (African American) and Jimmy (Caucasian). Both students were 13-year old males and had a low socioeconomic status (determined if student receives free/reduced lunch). Jimmy was receiving an F and Ben was
receiving a D in science class. At this point, Jimmy had two out-of-school suspensions and three in-school suspensions. Ben had no suspensions but five detentions. Academic achievement data was collected from the whole class.

The study took place in a middle school classroom, during an inquiry-based science unit. The inquiry-based science unit consisted of students working in groups to develop research questions, investigating the research question and sharing the information they gathered with multiple audiences. Specifically, the students researched types of activities that affect our planet’s carbon footprint and created a research question related to the topic to investigate. The student’s chose the specific areas they wanted to investigate (i.e. electricity, waste use). Next, the students investigated the questions by asking local businesses of their choice, how their company affects the planet’s carbon footprint. Then, they discussed in their group what these businesses could do to decrease their footprint. Finally, they created a presentation and an essay about their research findings and implications. The research questions the students created were from big ideas related to the science standards.

**Intervention and Related Materials**

Students were given a self-monitoring sheet at the end of every class (see Figure 1). On this sheet, the students rated their on-task and disruptive behavior that occurred during class by rating a series of items. This sheet was adapted from Bruhn and Watt (2012) and Wood and colleagues (2002). It was adapted to include behaviors that would be considered on-task and non-disruptive in an inquiry-based classroom. It included a Likert scale from 1 to 5 that was used for the students to rate their behavior. The teacher also rated each student’s behavior at the end of every class in the teacher section of the recording sheet. The students received a reward (e.g. computer time, candy) and one point at the end of class if their behavior ratings reached 30 or more (75%) and matched 7 out of 10 ratings (70%) with their teacher. If the teachers rating was higher than the student’s rating, the teacher gave the student a point for matching. The students were able to use the points they earned to get other reinforcements at the end of the study (e.g. gift cards, ice cream party).

Other materials included a pre/posttest that was used to measure academic achievement. This assessment consisted of a total of thirteen questions: 4 multiple choice, 5 fill-in the blank and 4 short answer. In order to assess whether the teacher and students thought of the
intervention as fair, effective and easy to use, they were administered a social validity questionnaire (See Appendix A and B). The social validity questionnaire was author made and was adapted from Bruhn and Watt (2013). It consisted of five questions and the students and teacher rated items on a Likert scale from one (strongly disagree) to five (strongly agree). It consisted of 25 possible points, and the higher the rating, the higher the social validity. Students were asked to give explanations for lower ratings. In order to assess whether the instruction was inquiry-based the teacher filled out a treatment fidelity rubric (See Appendix C). This consisted of items about the instruction such as minimal teacher talk and student discussion, researching and negotiating ideas.

Figure 1. Self-Monitoring Sheet

<table>
<thead>
<tr>
<th>Self-Monitoring Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: ________________</td>
</tr>
<tr>
<td>1= not at all 2=rarely 3= most of the time 4= all of the time</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1. Followed Directions</td>
</tr>
<tr>
<td>2. Stayed in seat during class time unless allowed to leave it</td>
</tr>
<tr>
<td>3. Accepted teacher comments appropriately (did not talk back or roll eyes)</td>
</tr>
<tr>
<td>4. Stayed on assigned task</td>
</tr>
<tr>
<td>5. Communicated with peers or teacher about science</td>
</tr>
<tr>
<td>6. Asked questions about science or project</td>
</tr>
<tr>
<td>7. Started working on science project or activity right away</td>
</tr>
<tr>
<td>8. Did not talk to other students about topics not related to class</td>
</tr>
<tr>
<td>9. Used materials appropriately (pencils, books, computer)</td>
</tr>
<tr>
<td>10. Did not have confrontations with others</td>
</tr>
</tbody>
</table>

Total Behavior Rating by Student (All of the ratings the student gave to self, added together)

Total number of matched ratings between teacher and student (Each time that the student and teacher rated the same is one)

*If you gave yourself a total rating of 30 or above and matched 7 out of the ten ratings with the teacher, you the choice of these rewards: A brave duck, a piece of candy, computer time at the end of class, talk free time at the end of class, listening to music while you work or permission to sit in the teacher’s chair for part of class.

* If you have 6 or more points by next Friday, they can be redeemed for other rewards such as a provided lunch with your adult of choice, an ice cream party or a gift card.

Figure 1. Self-monitoring sheet the participants and teacher filled out at the end of every class.
**Dependent Variables**

On-task behavior was defined as actively engaging in classroom activities. Examples included appropriate behaviors that would be seen in an inquiry-based science environment. These included communicating with peers and teachers about science, working on discovery learning tasks, negotiating scientific ideas, and engaging in scientific practices. Non-examples included talking about material unrelated to class, working on something other than a class activity or project or doing nothing at all (e.g. starring off).

Disruptive behavior was defined as any act that interrupted the teacher or peers from participating in classroom learning. Examples included being inappropriately out of seat, talking about topics unrelated to class, verbally refusing to participate, making inappropriate noises and not using materials appropriately (e.g., tapping pencil, slamming book, searching websites not related to class). This definition is comparable to the definition used by Bruhn and Watt (2013).

Based on Barlow, Nock and Herson’s (2009) recommendations of gathering valid and reliable single subject data, this study used the sampling method of interval recording, which is the most widely used and flexible sampling method. Jimmy and Ben were observed for 30 minutes each day of the study, using interval observations. Observations for each student were alternated and each student was observed for 30 second intervals (10 minutes total). A whole-interval system was used for on-task behavior. Students were recorded as on-task if they showed on-task behavior the entire 30 second interval. For disruptive behavior, a partial-interval system was used. Students were recorded as being disruptive if they showed disruptive behavior at any time during the 30 second interval. A percentage will be calculated by dividing the total number of intervals the student showed on-task behavior by the total number of intervals observed (20) and then multiplying that by 100. The same was done for disruptive behavior. Inter-observer agreement (IOA) was also collected for 30% of the sessions. Reliability data was collected by having the primary observer observe the students before the study began. The IOA was calculated by dividing the number of intervals with agreements by the total number of intervals (agreements + disagreements) and multiplying by 100. The researchers were considered reliable by reaching 90% agreement on 3 consecutive sessions prior to the first study observation.

Academic achievement of science vocabulary pertinent to the unit of study (carbon footprints) was measured throughout the intervention using a pre/posttest design. This
measurement was administered to all of the students in the classroom so that Jimmy and Ben
were not treated differently. However, all of the students’ results on this measurement were used
to determine if there was academic growth; therefore, a paired-samples t-test could be used. The
results from the aforementioned vocabulary quiz was used to determine academic growth.

Procedure

There are nine steps in this procedure.  (1) Students were selected for participation in the
study based on parental consent and teacher recommendations. (2) Baseline data were collected
for the students’ on-task and disruptive behaviors. (3) Students took the pretest for the academic
achievement measure. (4) Students were trained in the self-monitoring intervention. (5) Students
filled out the self-monitoring sheet at the end of every class and were also reminded of behaviors
on the sheet throughout class. (6) The teacher filled out the teacher matching portion of the sheet
and rewarded the students with a point and the choice of an artificial reinforcer. (7) At the end of
the study, the students were able to exchange their points for additional reinforcers identified by
the students and teacher as acceptable. (8) Students took the posttest at the end of the study. (9)
The students took the self-monitoring sheet to one other class with them after the completion of
the initial study for the purpose of collecting generalization data.

Experimental Design and Analysis

For the purpose of determining the effects of the self-monitoring intervention of on-task
behavior, disruptive behavior and academic achievement, a mixed methods approach was used
that embedded a multiple baseline across participants design and a pre/posttest design. The
independent variable in this study is the self-monitoring intervention. The dependent variables
include interval observation of on-task and disruptive behavior and the pretest/posttest for
academic achievement. The number of observed on-task and disruptive behaviors will be
divided by the number of observed intervals to determine a percentage of observed behavior for
each ten minute observation. These data will be graphed and a visual inspection of the graphs
will determine if a functional relationship exists between on-task behavior and disruptive
behavior with self-monitoring. In addition, an effect size will be calculated using PND
(percentage of nonoverlapping) to determine the magnitude of the overall effects. PND was
chosen because research has shown that it has been a suitable method for visually inspecting
single subject data for the past 25 years (Scruggs & Mastropieri, 2013). In addition, the Tau U
score will also be calculated. Tau-U was chosen to also be reported because it controls for baseline trend, combines non-overlap with trend and looks at change in the group instead of individual change (Parker, Vannest, Davis & Sauber, 2011). A paired samples t-test was used to determine if individual growth from pre to posttest on the measure of academic achievement (science vocabulary) was significant. Two subjects was too small of a sample to run a paired samples t-test; therefore, the analysis was run using the whole class.

Results

The first research question asked what the effect of a self-monitoring procedure would be on the on-task behavior, disruptive behavior, and academic achievement of at-risk middle school students in an inquiry-based science unit. The second question asked what the effect would be when generalizing the self-monitoring intervention into one other setting. There were three baseline points collected that consisted of behavior that occurred during traditional instruction and during inquiry-based instruction. The first data point was collected during traditional instruction and the second and third were during inquiry-based instruction in order to compare the student’s behavior during both types of instruction. However, when determining effect sizes, intervention data was only compared to the second and third baseline points to see if there was a change in behavior during inquiry-based instruction. Intervention data were collected for six days for one student and five days for the other student due to absences. Generalization data were collected for three days for one student and only one day for the other. IOA was 100% during baseline and the intervention phase.

On-task Behavior

Ben. Ben’s on-task behavior did not change a significant amount from traditional to inquiry-based instruction in the baseline phase. Ben’s on-task behavior was low during both traditional and inquiry-based instruction in the baseline phase and high during the intervention and generalization phase. He was on-task for a mean of 30% of intervals during baseline. He was on-task for a mean of 66.7% of intervals during the intervention phase. During the intervention phase, Ben’s on-task behavior showed an increasing trend with a slope of 1.143. Data were only collected one day for Ben for the generalization phase and he was on-task for 75% of the intervals. Figure 2 shows the observed intervals for each phase.
Jimmy. Jimmy’s on-task behavior decreased significantly from traditional instruction to inquiry-based instruction during baseline. Jimmy was on-task for a mean of 52.5% of intervals during baseline. He was on-task for a mean of 70% of intervals during the intervention phase, which showed an increasing trend with a slope of 3. During the generalization phase, he was on-task for a mean of 83.3% of the intervals. Figure 2 shows the observed intervals for each phase.

Effect Size. PND and Tau-U were both calculated to determine the overall effects of the intervention. Both effect sizes were high for on-task behavior. The PND was 100 and the Tau-U was 1.00 (p=.0034, var-tau=.3418, 95% CI [.33, 1.67]).

Disruptive Behavior

Ben. Ben’s disruptive behavior increased from traditional instruction to inquiry-based instruction during the baseline phase. Ben was disruptive for a mean of 55% of intervals during the baseline phase. He was disruptive for 30.8% of the intervals during the intervention phase. Ben’s disruptive behavior showed a decreasing trend with a slope of -4.17 during the intervention phase. During the generalization phase, Ben was disruptive for 15% of the intervals. Figure 2 shows the observed intervals for each phase.

Jimmy. Jimmy’s disruptive behavior significantly increased from traditional instruction to inquiry-based instruction. His disruptive behavior showed some variability throughout the intervention. He showed a mean of 35% of disruptive behavior during baseline and a mean of 38% during the intervention phase. During the intervention phase, Jimmy’s disruptive behavior showed a decreasing trend with a slope of -7. During the generalization phase, his mean disruptive behavior was 8.3%. Figure 2 shows the observed intervals for each phase.

Effect Size. A moderate effect size was calculated for both students for disruptive behavior. The PND was 46.65 and the Tau-U was .5985 (p=.0799, var-tau=.3418, 95% CI [-1.2684, 0.0714]).
Figure 2. Single subject graphs showing the percentage of intervals each student was on-task and disruptive in each observation session.

Academic Achievement

All of the students in the class were administered a pre and a post science vocabulary quiz to measure academic achievement. A paired-samples t-test was used to determine a difference between all of the students’ pre and posttest scores. The paired-samples t-test indicated a significant difference between the pre and posttest, \( t(7) = -2.174, p < .05, 95\% \text{ CI } [-2.45, -1.13] \). The scores on the pretest, \( M = 5.86(1.57) \), were lower than the scores on the posttest, \( M = 7.14(1.86) \).
Social Validity and Treatment Fidelity

Overall, students rated their social validity questionnaire high. Ben gave a total rating of 19 and Jimmy gave a total rating of 20. Ben rated the question about fairness the lowest. When asked why he gave this answer, he said he was frustrated at the time for not meeting the criteria for the reward that day. Jimmy answered all of the questions about the same. Scores from other students in the class included a 22, 24 and five 25’s. The teacher also rated her social questionnaire high. Her total score was 21. The treatment fidelity rubrics were filled out with 96% agreement. Therefore, the researcher and the teacher agreed that the instruction was inquiry-based (as described on the rubric) 96% of the time.

Discussion

Discussion Overview

The results described in the previous chapter show that self-monitoring is an effective strategy to use during inquiry-based instruction in order to increase on-task behavior, academic achievement and to decrease disruptive behavior for students that are at-risk for school drop-out. These results also indicate that the generalization of a self-monitoring intervention can produce positive results. This chapter will include sections on the summary and interpretation of the findings, implications, limitations and future research.

Summary and Interpretation of the Findings

The first research question asked what the effect of a self-monitoring procedure would be on the on-task behavior, disruptive behavior and academic achievement of at-risk middle school students in an inquiry-based science unit. The second research question asked what the effect would be when generalizing the self-monitoring intervention into one other setting. This section will discuss each finding related to the research questions.

On-task behavior. Ben and Jimmy both showed an improvement in on-task behavior when using the self-monitoring intervention. Throughout the five days of using the self-monitoring intervention and starting the inquiry-based science unit both students showed an increasing trend in behavior. There was also a high effect size calculated for both students’ on-task behavior. Research indicates that when working with students who are struggling
academically or behaviorally during an inquiry-based environment, it may be more difficult for them to stay on-task due to the lack of structure (Therrien et al., 2013; Watt et al., 2013). This study showed that the student’s on-task behavior either decreased or stayed the same when switching from traditional instruction to inquiry-based instruction. However, when the self-monitoring intervention was introduced, the student’s on-task behavior increased. These results show that these students were able to stay on task during the inquiry-based activities such as group work when using the self-monitoring intervention.

Disruptive behavior. Ben’s disruptive behaviors decreased when using the self-monitoring intervention during inquiry-based instruction. Jimmy did not show an overall improvement in disruptive behavior from the baseline phase to the intervention phase. However, his behavior was on a downward trend. In addition, all of Jimmy’s disruptive behavior data points during the generalization phase were below the baseline phase except for one. His behavior on this day could be because of the substitute teacher or because Jimmy was sitting right next to the camera. The majority of behavior that Jimmy portrayed this day was tapping his fingers and his pencil and making noises with his mouth. These are all behaviors that can disrupt other students but Jimmy could still be considered on-task. The effect size for both students was in the medium range. The results suggest that the self-monitoring intervention was effective at decreasing one student’s disruptive behavior during inquiry-based activities.

Academic Achievement. All of the students in the class were given a pretest and a posttest on vocabulary that was discussed in the inquiry-based science unit but not assessed specifically. The students performed better on the posttest than on the pretest. While this suggests students using self-monitoring in an inquiry-based classroom show increased academic learning, results need to be interpreted with caution. It is difficult to determine without an experimental design if the findings can be attributed to just one of the interventions. Further research in this area is warranted.

Limitations

The first limitation is the small sample size. This study only included two participants. The study began with three participants but one participant was dropped due to a discipline issue. This incident also caused inconsistency of teacher attendance. These limitations are due to the nature of working with students who show characteristics of emotional/behavioral disorders and
are enrolled in an alternative setting. This aspect and the small sample size makes it difficult to generalize the results to other populations. However, throughout the study, a distinct difference in behavior was observed. The sample size was also too small to run a paired samples t-test for the academic achievement measure. Therefore, the statistic was run using the scores of the other students in the class that also participated in the self-monitoring intervention but were not directly observed.

The second limitation is the length of the study. The short length of the study only provided enough time for two baseline points and only seven to eight intervention and generalization points. A longer study would have produced a greater amount of data points. This would have provided information on whether the behaviors would have continued in the same pattern and would have strengthened the validity of the results.

**Implications**

The findings from this study suggest that self-monitoring is an effective strategy to use during inquiry-based instruction to support behavior and engagement. Working with students to help them become aware of their behavior and teaching them how to monitor these behaviors can be an effective strategy and is also consistent with research (Amato-Zech et al., 2006; Blood et al., 2011; Bruhn & Watt, 2012). The findings also suggest that each student may react differently to the intervention. Therefore, when using this intervention in practice, it is beneficial to individualize the intervention based on student needs and related motivation factors.

Inquiry-based instruction is ideal when used with structured supports. The results of this study suggest that self-monitoring is effective at supporting students in an inquiry-based setting. In this study, the intervention was able to decrease unwanted behavior, increase wanted behavior and indirectly increase academic achievement. Although, academic achievement did increase, it is important to use caution when interpreting this aspect. However, this study indicates that self-monitoring will most likely increase on-task behavior, disruptive behavior and academic achievement for students during an inquiry-based unit. All of these behaviors are crucial behaviors for academic and life success.

This study also supports research by suggesting that positive reinforcement can produce positive results (Bruhn & Watt, 2012; Freeman & Dexter-Mazza, 2004). The students were
rewarded when they were rated high by themselves and by a teacher. This type of reinforcement is called matching and it may have motivated the student’s throughout the study. Some research has shown that a self-monitoring intervention can produce positive results when generalized into other settings (Amato-Zech et al., 2006; Peterson, et al., 2006). The student’s in this study used the self-monitoring intervention in one other class (English) and the results were positive. They both showed lower disruptive behavior and higher on-task behavior during the generalization phase. This shows that students are able to monitor their behavior in multiple settings different from the one they learned to monitor their behavior in first.

Future Research

In conclusion, this study was able to add to the literature examining effective strategies for at-risk students. It examined one strategy that is effective when working with these students. It also addressed the need for effective strategies to use with struggling students during inquiry-based instruction. The results of this study supported the hypotheses that were proposed. The self-monitoring intervention increased the on-task behavior for both students and decreased the disruptive behavior of one student. Both students were able to generalize their behaviors into one other setting.

For future research, there is a need for further research on effective strategies to use with struggling students in inquiry-based classrooms. In addition to research examining interventions to increase behaviors and content acquisition, it is also critical that we evaluate tools to help students understand scientific practices. This type of instruction is taking the place of normal classroom instruction. Many professional organizations such as the National Science Foundation and the National Research Council have encouraged teachers to use inquiry-based instruction in their science classrooms (Minner, et al., 2009). Therefore, there is a need for more research in this area because of the recent increased use. Considering this study was completed in an alternative setting, there is a need for the replication of this study in the general education setting. This will enable the results to be generalized to other populations.
References


Appendix A

Student Social Validity Questionnaire

Social Validity Questionnaire

Circle 1-5 for the following questions about the self-monitoring sheets you filled out every day.

1= strongly disagree  2= disagree  3= undecided  4= agree  5= strongly agree

1. This intervention was easy to use.  1  2  3  4  5
2. This intervention helped me to complete my work.  1  2  3  4  5
3. This intervention helped me to stay on task during class.  1  2  3  4  5
4. This intervention helped me succeed in class.  1  2  3  4  5
5. This intervention was a fair way to help me in class.  1  2  3  4  5
Appendix B

Teacher Social Validity Questionnaire

Social Validity Questionnaire

1= strongly disagree 2= disagree 3= undecided 4= agree 5= strongly agree

1. This intervention was easy to implement. 1 2 3 4 5
2. This intervention would have been easier to implement with a smaller number of students. 1 2 3 4 5
3. This intervention addressed the student’s problem behaviors. 1 2 3 4 5
4. This intervention fit the classroom structure. 1 2 3 4 5
5. This intervention created a positive change for the students. 1 2 3 4 5
Appendix C

*Treatment Fidelity Checklist*

**Inquiry-Based Instruction**

Minimal teacher talk, primarily student discussion.

Students spend majority of class discussing, researching, and negotiating ideas about carbon footprint.

Students have access to multiple forms of information (i.e. computers, articles, books, etc).

Students are working toward developing/examining a specific research question.