A Model for Classroom-Based Intervention for Children with Sensory Processing Differences

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Abstract

This study examines the impact of a general education classroom-based sensory program for students exhibiting sensory processing differences in the school environment. Students were divided by age and degree of sensory needs between control and experimental groups, with teachers of students in the experimental group implementing the recommended sensory program (BrainWorks) with all students in the classroom. In spite of the top-down nature of the training for teachers, which generated a skeptical and in some cases resistant teacher population in both groups, results demonstrated a positive impact, although the degree of magnitude differed across classrooms and age groups. Of equal significance is difference in teacher implementation structures, which provides input for future training approaches. The degree of change in classroom performance of students in the experimental group suggests that training for teachers with students who have sensory differences is effective and that students can benefit from a classroom-based sensory program as an investment in classroom performance. The significance of this study is that it goes beyond the therapeutic environment, where sensory processing is more commonly measured, and evaluates actual classroom-level/educational setting impact, with concrete implications for effective classroom interventions. Future research in this area could expand to evaluate actual academic gains as measured by standardized academic scores, furthering the data in this study which evaluated performance on standardized sensory and behavioral measures.

Introduction and Rationale

Sensory Processing Disorder (SPD) is a condition that impairs an individual's ability to organize input from sensory sources and react according to that input (Alibrandi, Beacock, Church, Des Moines, Goodrich, Harris, Sprague, & Vrtovsnik, 2014; Murray et al, 2009). SPD can take the form of Sensory Modulation Disorder, which is associated with under- or over-responsiveness to sensory input such as touch, movement, or other sensations; Sensory-Based Motor Disorder, involving difficulty organizing and sequencing tasks related to physical movement; or Sensory Discrimination Disorder, which limits the ability to distinguish among visual, movement, auditory, tactile, and other sensory input (Alibrandi et al, 2014; Murray, Baker, Murray-Slutsky, & Paris, 2009). SPD often coincides with autism spectrum, attention deficit, behavior, anxiety, or attachment disorders (Sensory Processing Institute for Research and Learning, 2006). Although SPD is not included in the DSM-V, these sensory integration issues create challenges in academic and daily living settings and can be treated through regular therapies and sensory integration programs (Sensory Processing Disorder Foundation, 2014).

Studies on the impact of clinically-based therapy, the use of sensory strategies, and movement breaks provide a rationale for developing the capacity for teachers to provide a classroom-based intervention for students with SPD. This study investigates the impact of a program that involves training teachers in the implementation of sensory strategies and movement breaks as reflected in student gains in sensory processing and behavioral measures. While particular to an individual school, the impact of these measures in a short-term program reinforces other studies reflecting similar benefits (e.g. Worthen, 2010). It is the hope of researchers that this study can contribute to increasing work in this area so that students impacted by sensory processing challenges can improve their academic focus, learning, and behaviors that

will support their growth and achievement of their potential as students and community members.

Review of Research

According to the Sensory Processing Institute for Research and Learning (2006), between 5-13% of students enter school with sensory processing disorder. This disorder can involve behaviors that directly impact classroom performance socially and academically. Aspy & Grossman (2007) note that behaviors resulting from SPD impede social and cognitive function on many levels, which in turn impairs classroom performance and learning. Children with SPD often suffer inconsistent attention and arousal, behaviors involving movement or self-stimulation, impairments in communicative responses, and difficulties with daily routines or social interactions (Pfeiffer, Koenig, K., Kinnealey, M., Sheppard, M., & Henderson, 2011; Schoen, Miller, & Sullivan, 2015; Worthen, 2010).

Sensory-seeking behaviors may involve jostling, pushing, misusing materials, inappropriate movement or touching, and other behaviors perceived as disruptive; sensory avoiders may have difficulty with noise, lines, and various activities in the classroom or school setting. Sensory dysregulation can lead to attentional difficulties, distractibility, difficulty processing multi-step directions, and challenges with managing transitions. Sensory dysregulation can interfere enormously with academic performance, learning, and social participation, limiting the prospects for successful school experiences (Alibrandi et al, 2014; Aspy & Grossman, 2007; Reebye & Stalker, 2008; Sensory Processing Institute for Research and Learning, 2006).

Research on SPD Interventions in Therapeutic Settings

Historically, Aspy & Grossman (2007) note, there is a great deal more practice in the field of therapy for SPD than research. Of the research that exists, there is much more related to

clinical impact than classroom; some of this research demonstrates the effectiveness of sensory integration therapies and sensory strategies.

The Sensory Processing Disorder Foundation (2014) shows the impact of an intensive short term intervention conducted in a clinical setting with parental support where over the course of 30 sessions, 98 children demonstrated gains well above the expected level. A study by Pfeiffer et al (2011) showed gains in social responsiveness and self-regulation through a sensory processing program for a group of 6-12 year olds receiving 18 therapeutic sessions over a 6-week period in a summer program. A study by Miller et al (2007) found significant results in attentional and internalizing functions as the result of a 10-week intervention with 24 children with various disabilities and sensory processing challenges with the average age of 6.

Research on School-based SPD Interventions

Most of this research has been undertaken without direct linkages to classroom performance. A few studies, however, have looked directly at teacher use of sensory integration methods to improve academic performance, and there is a growing realization that the classroom is the most natural setting to evaluate the impact of sensory interventions (Worthen, 2010). In 2001, Keller examined the impact of using sensory integration strategies to improve handwriting. Her approach combined gross motor activities as a warm up, fine motor warm up activities, followed by direct instruction in letter writing, guided practice, semi-independent, teacher-guided practice, and then independent practice. Her findings, conducted in a single setting, found that student learning objectives were met; additionally student awareness of using sensory strategies to self-regulate also developed.

A study of the impact of providing sensory input during work at desks found that participation and on-task activity improved significantly (Schilling & Schwartz, 2004, cited in

Aspy & Grossman, 2007). In a school-based study, Parham (1990) found that a long term intervention had the greatest impact on the academic functioning of children 6-8 years old, notably in the area of math; the impact of the intervention diminished as children grew older.

In a review of recent research on the impact of sensory interventions on classroom behavior, Worthen (2010) found that there was in fact a positive impact in numerous research studies focused on preschool through elementary-aged students, both those with and without developmental differences or disabilities. Among key findings was that the use of auditory input such as calming music to enhance work efficiency, alternative seating devices and postures for improving attention, tactile stimulation and pressure to reduce off-task behaviors, and other interventions produced positive outcomes for groups of students in the studies reviewed. As a result, Worthen (2010) recommends that school-based OTs develop programs with sensory strategies for use in general education classrooms to improve behavior and attention and promote academic achievement.

Several studies have examined the effectiveness of teaching self-regulation strategies to students and have noted positive results. A study of pre-school children found that self-regulation serves to mediate classroom skills, and that curricula that incorporate teaching of strategies for self-regulation can have a positive impact on student behavioral, social, and academic performance (Raver, Li-Grining, Bub, Jones, Zhai, & Pressler, 2011). Shanker (2013) describes interventions to promote self-regulation that is critical to higher order and metacognitive thinking in the classroom. Another study on the classroom impact of self-regulation found that when students are dysregulated, their attention shifts to a search for a return to regulation, withholding attention from the learning task (Boekaerts & Corno, 2005). Often the use of coping mechanisms can be “bottom up” – i.e. used to cope with challenging external

stimuli rather than top-down –an attempt to prepare for learning (Boekaerts & Corno, 2005, p. 204). Boekaerts & Corno (2005) further point out that all students face stressors, but that students with sensory differences face chronic internal and external stressors that undermine the path to learning goals (p.204). Teaching coping mechanisms is essential for ongoing self-regulation socially and academically (p.204) because when students have access and the will to use regulation strategies, they can maintain a focus on goals (p. 206). Direct teaching of the use of strategies – an inherent part of this study's intervention – can be an important step for students' progress toward their own approach to self-regulation.

In addition to direct sensory processing interventions, there is an emerging body of research on the value of movement breaks for students in school, not merely those with SPD (e.g., Jensen, 2000; Mulrine, Prater, & Jenkins, 2008; Swinth, 2015). Movement provides stimulus to the brain, increases levels of neurotransmitters that improve mood and focus, allows for processing time, and provides a break from learning that in turn allows students to refocus. Effective movement breaks can include those that vary posture and access to material during learning as well as breaks for stretching, walking, and other exercise (Jensen, 2000). Many researchers believe that movement is essential to optimize learning and achievement, and can support attentional gains and behavioral improvement (e.g., Mulrine et al). Incorporation of movement is an important aspect of this study's intervention.

Teacher Knowledge

In spite of the emerging body of research regarding the benefits of sensory strategies and movement breaks in the classroom, provision of school-based services for sensory processing is still largely dependent on the district, or even the school-based OT, who has discretion over the type of OT services provided (Morris, 2007). Moreover, some research has shown that teachers have little understanding of sensory processing disorder or the implementation of sensory

strategies. Alibrandi et al (2014) report that while 87% of Head Start staff claimed familiarity of SPD, only 17% could provide an accurate definition; similarly, 53% reported knowledge of sensory diets, but only 10% could define them. When sensory processing disorder is misunderstood, teachers may misinterpret sensory-seeking or sensory-avoiding behaviors as problematic behaviors the child can control and attempt to eliminate them (Aspy & Grossman, 2007; Murray et al, 2009). In such cases, where the underlying state of dysregulation remains unaddressed, students may seek alternative behaviors, and learning and social integration will be undermined. Even among those with an understanding of sensory processing needs of children, the fact that sensory input is ongoing and cumulative may lead to misunderstanding of areas of difficulty (Aspy & Grossman, 2007).

If educational approaches are to succeed for students with SPD, teacher instruction regarding movement breaks and the use of sensory strategies to enhance sensory modulation will be necessary to enable these children to attend and maintain focus on instruction in their educational environment (Aspy & Grossman, 2007; Murray et al, 2009). Recognizing the importance of meeting sensory needs as a precondition for effective instruction, Aspy & Grossman (2007) include the sensory domain in their comprehensive model for instructional programming. Thus, consideration of this domain is critical, both in terms of managing the environment, and developing proactive sensory interventions so that a child can maintain regulation. Finally, Murray et al (2009) note that just providing sensory input is not enough; students need to learn strategies to meet their own needs, maintain a state of regulation, and develop alternative behaviors.

Context of this study

It is upon this foundation – the emerging research on the classroom impact of movement breaks, sensory strategies, student instruction in self-regulation, and the need for greater teacher

information in order to effectively implement such interventions – that this study examines the efficacy of a classroom-based program (henceforth referred to as the "BrainWorks Program") for children with sensory processing challenges. Based on a short OT-provided training program for teachers and subsequent teacher implementation of interventions for students with sensory challenges, the study examines sensory and behavioral improvements in classroom settings. Research questions guiding the study include the following:

Research Question 1. How does a classroom-based sensory modulation program impact sensory and behavioral measures for children with sensory processing differences, based on pre- and post-evaluations with the *Sensory Processing Measure* (SPM) and the *Behavioral Assessment System for Children* (BASC-2) (Ecker, 2010; Parham, 2007; Reynolds & Kamphaus, 2004).?

Research Question 2. What factors in teacher implementation impact the results? What other aspects of program implementation may impact outcomes?

Methodology

Setting

This study took place in a rural district which includes 48.7 percent economically disadvantaged students in the Elementary-Middle School grades, the focus of this study (XXX ISD, 2013[1]). The combined elementary and middle school has a total of 261 students, with good attendance rates, parent involvement, and standardized achievement rates across demographic groups. Overall achievement rates for NCLB reporting purposes meet the state's benchmarks for proficiency. In terms of third grade reading scores, for example, the district scores were 4%

[1] According to APA Guidelines, while retrievability of data sources is essential, the ethics of participant confidentiality outweigh this principle. Given the small size of the district, with only one elementary, middle, and high school, district names have been redacted, both in text, and in citations. Original documents remain in hard copy with researchers. Source: http://blog.apastyle.org/apastyle/2013/08/lets-talk-about-research-participants.html

higher than statewide levels in 2010-2011. Among Hispanic students, scores lagged by 7%, with subgroup data unavailable for other ethnic groups or students in special education. Results were similar in math, and throughout other grade levels reported (4th-6th); 6th grade reporting for special education students indicated a large lead in this district over statewide numbers; overall, the district is meeting benchmarks for Adequate Yearly Progress as defined by the state (ISD NCLB Report Card, 2012). Also according to this reporting, in 2010-2011, 94.9 percent of teacher's held a Bachelor's degree and 5.1 held a Master's degree; the previous year, the numbers were 82.7 and 17.3 respectively, likely reflecting either teacher turnover or statistical corrections.

Participants

Students were selected from classes where teachers undertook the training and subsequently implemented the BrainWorks program (the experimental group) and classes where teachers did not implement interventions (the control group). Researchers selected one teacher from each grade to be in the experimental group (with the exception of fifth grade, in which no students qualified for the study), based on balancing the number of students in the control and experimental groups. Students were divided into the control and experimental groups for equivalent numbers within the groupings of pre-kindergarten through second grade and third through sixth grades. Groups were also fairly balanced based on severity of sensory differences as measured by the SPM and the BASC-2. Overall, there were 24 students in the control group and 22 in the experimental. Teachers in both groups identified students with symptoms of sensory modulation disorder, which was covered in a staff training session.

As noted, these students were divided into control and experimental groups, with divisions occurring to deliberately balance the groups based on age and scores on the SPM and

BASC-2. Table 1 presents participant assignment based on grade and pre-intervention scores on the SPM and BASC-2.

Table 1. Distribution by Grade Level and Pre-Intervention Measures

	Control Group			**Experimental Group**		
Grades:	**N =**	**SPM**	**BASC 2**	**N**	**SPM**	**BASC 2**
PK-2	11	61.7	53.07	14	66.23	56.47
3-6	13	58.71	53.02	8	56.13	50.71

Intervention: Training and Implementation

Teachers with students in the experimental group participated in the initial training and received on-going instruction and support from the OT Researcher over the course of the 10 weeks. This included all teachers from second grade through sixth because students move among teachers starting in second grade, and teachers would therefore implement interventions for those students in the experimental group when they were in their classrooms. For students in grades 2-6, it was the homeroom teacher who completed the assessments for the students included in this study.

The intervention was designed and implemented by a licensed Occupational Therapist (referred to henceforth as OT researcher), using the BrainWorks program. After her on-site training, she maintained at least weekly contact with teachers for support as they implemented the sensory program. There was also an on-site assistant, a paraprofessional who serves in the school's motor lab (a program based on "Ready Bodies, Learning Minds"), available to check in with participating teachers and relay information to the OT researcher.

Teacher training began with an in-service conducted by the on-site research assistant in August before school started. This session focused on the signs and symptoms of sensory processing disorder and provided the teachers with a basic checklist to identify children who may

have SPD. The trainer outlined the process for involvement in the study at that time as well. At the conclusion of that training session, all teachers were asked to complete an online survey to gather information on teacher's experience level, their current level of understanding of sensory processing disorder, and their previous use of sensory strategies in the classroom. All of the teachers completed the survey before students began attending school.

In the initial teacher training session, each teacher was asked to identify 2-4 students with signs and symptoms of sensory processing disorder. Parent consent-to-evaluate forms were sent home with those children. Consent was received for 50 out of 60 of the identified students. For the students with parental consent, teachers were asked to complete the SPM or SPM-P (used for students aged 5 and younger in the Pre-Kindergarten classrooms) and BASC-2 assessment forms in September after having had the children in their classes for five weeks. The on-site research assistant provided both verbal and written instructions (prepared by the OT Researcher) for the teachers regarding the guidelines for completion of the assessments. The OT Researcher scored the assessments. Four students were eliminated from the study due to scoring within the typical range on both assessments, leaving the total number of students involved in the study at 46.

On-site teacher training by the OT Researcher took place during two days in late September after the assessments were completed and group assignments (experimental and control) had been determined. The OT Researcher conducted a one-hour in-service training session after school on each of those two days. All teachers were required to attend the first one and only teachers who had students in the experimental group were required to attend the second session. The first training session explained the purpose of the study, covered sensory modulation, the benefits of movement breaks, and the use of BrainWorks tools for students to

monitor their need for sensory strategies (using the BrainWorks Tachometer) and select appropriate strategies to enhance self-regulation (using a BrainWorks folder with picture icons for different kinds of activities related to sensory systems that are "too fast," "too slow" or "just right"). The second training session was titled "Sensory Diets in the Classroom" and covered a variety of calming, alerting, and "just right" activities that could be carried out in the classroom setting as well as a variety of sensory modifications and adaptations that could be helpful to the students in the experimental group. This training also outlined the components of the intervention program. Additionally, the OT Researcher met individually or in small groups with the teachers in the experimental group for approximately 20 minutes to go over the assessment results of each of their students and to make individualized recommendations for those students. The BrainWorks program for students in the experimental group included the following:

1. "Brain Breaks" every 15-20 minutes for students in Pre-K through Grade 2, every 30-40 minutes for grades 3-4, and every 50 minutes for grades 5-6. "Brain breaks" were defined as short opportunities (30 – 90 seconds) to move the whole body. Teachers were provided with BrainWorks Activity Cards to guide appropriate activity selection. The recommended activities were primarily proprioceptive in nature such as isometric exercises, deep pressure to the head, wall push-ups, etc. It was recommended that all "Brain Breaks" should be followed by two "belly breaths" (deep breathing that causes the abdomen to expand outwardly).
2. "Sensory breaks" twice per day for students in all grades. "Sensory breaks" were defined as longer (at least 10 minutes) opportunities for movement and sensory input. Teachers were given options for sensory breaks through the use of BrainWorks Activity Cards representing activities such as yoga, classroom exercises, and

movement songs as well as access to GoNoodle.com (website providing video-guided movement breaks).

3. Classroom instruction in the identification of sensory needs through the BrainWorks tools. Instruction options included the book titled "Arnie and His School Tools" for the younger students, teacher instruction, a short video explanation prepared and presented by the OT Researcher, and having the class receive instruction directly from the OT Researcher via Skype. Teachers were asked to use the BrainWorks analogy and tachometer frequently throughout the duration of the study.
4. The use of sensory equipment provided by the OT Researcher on an as-needed basis. Equipment included FootFidget® Footrests, Kore Wobble Stools, noise-reduction headphones, fidget toys, weighted lap pads, and therapy balls for seating.
5. Modifications and adaptations per OT Researcher recommendations such as dimming the lights, playing modulating music, and preferential seating.

Recommendations by the OT Researcher for individualized sensory strategies or the use of sensory equipment were based on the OT Researcher's professional interpretation of the assessment tools as well as the use of *SPM QuickTips*, (Henry, 2007) a tool that assists clinicians in the selection of appropriate intervention strategies based on the results of the SPM.

Post-training, teachers spent 10 weeks implementing the program as outlined above and remained in contact via email and phone calls with the OT Researcher. The on-site research assistant stopped by the classrooms assigned to the experimental group regularly to observe and assure follow-through of the program components. Apparent lack of follow-through was reported to the OT Researcher and the principal. The principal communicated with the teachers regularly as well and let the OT Researcher know of potential issues with teacher follow-through. At the

end of the 10 weeks, teachers completed the SPM or SPM-P and BASC-2 assessment scales for each student and completed another online teacher survey.

Data Collection and Analysis

Data collection was purposeful and thorough in order to examine various facets of the study and to elucidate variables that may impact both research results and the conduct of future studies in this area. As a validity strategy (discussed further below), data in each category were triangulated so that greater insight and interpretive validity could be applied through transparency and reporting.

To respond to Research Question 1, the impact of the intervention on student classroom functioning, the primary data sources were the scores on pre- and post SPM or SPM-P and BASC-2 assessments for students in the control and experimental groups. Teacher feedback on the impact of the intervention was a secondary source. In order to examine research Question 2, the implementation of the sensory program and movement breaks, we examined the data from evaluations completed by teachers, teacher implementation records, and the post-implementation teacher surveys. Secondary data sources which were used to triangulate and make meaning of the primary data results were field notes from the OT conducting the training focused on educational setting and teacher response to training on the intervention, and implementation notes based on communications between the OT trainer and participating teachers.

Prior to the training, and at the conclusion of the 10-week intervention, teachers in both the control and experimental groups completed the SPM (or SPM-P) and BASC-2 for each identified student to evaluate the impact of the interventions on the sensory and behavioral areas identified in each measure. These scores were compared to determine the level of change in

individual behaviors, processing, and other factors measured as well as to determine overall level of performance changes by student as well as grouped by teacher.

At the conclusion of the study, teachers completed a survey on their experiences implementing the intervention. The results were reviewed overall, to determine the impact of the training, as well as individually, to look for differences in implementation that could impact student results. Questions focused on teacher learning, implementation of movement breaks, implementation of sensory breaks, use of self-regulation and choice tools, and overall perception of the impact of the intervention on students' classroom behaviors. Student scores were used as a framework for examining areas of teacher implementation. This relied on starting with student scores at the high and low end of the ranges, and then examining teacher reporting on implementation, first, through the overall perspective reported in their final survey, and then through the data in their implementation reports. These data were also compared to the OT trainer's notes and correspondence during implementation.

Validity Measures and Checks

This study relies on several forms of validity. First, for triangulation purposes, we sought to examine data points from multiple perspectives. These are summarized in Table 2. Next, in order to avoid easy conclusions, we examined our results for discrepant data, both in terms of student performance and teacher implementation, or other mitigating factors identified in field notes and/or teacher correspondence. As a further validity strategy, we examined the notion of participant reflexivity. This is particularly important in examining the teacher implementation notes and teacher surveys. In terms of the experimental effect and the validity of results corresponding with student growth, students from both the control and experimental groups were measured in late September and after the 10 weeks of the study; while there would have been

acculturation effects, those would present equally in both groups, allowing for examination of differences based on the independent variable of the BrainWorks program's effect.

Table 2. Summary of Triangulation Methods Used in Data Analysis

Data source	**Triangulation**
Baseline BASC and SPM Scores	• Examination of field notes from training • Purposeful sampling and assignment to control and experimental groups
Post-implementation BASC and SPM Scores	• Comparison with datasheets for details on interventions by various teachers to look for patterns • Examination and disclosure of mitigating factors in implementation
Teacher Implementation Repots	• Comparison with teacher surveys • Comparison with student results • Search for discrepant data
Teacher surveys on their experiences implementing the measures	• Triangulation with implementation notes • Triangulation with student outcome scores • Search for discrepant data

Exceptional student cases. A few cases may impact evaluation of data and should be noted; both cases weaken the results in terms of noting change. First, in the case of one student, he was transferred from an experimental to a control classroom during the study. Both the transfer and the fact that a teacher in the control group completed his evaluation may have rendered his gains less significant. Next, one student in the control group was having difficulties in class, and consequently received additional supports. His results may have shown greater improvements overall, thus making the experimental groups' results appear relatively less impactful.

Findings

Given the fact that the students in the study had sensory issues that had previously been unaddressed, the fact that the intervention demonstrated improved classroom functioning is perhaps unsurprising. However, within the results, there was variation both among categories of

sensory function and between age subcategories. In addition, the approach of individual teachers in the way that they implemented interventions also produced differential results. Because recent guidelines on human subjects and classroom interventions recommend that the greatest validity in reporting the results of such interventions is presented through percentage change rather than p-scores (Lipsey, Puzio, Yun, Hebert, Steinka-Fry, Cole, Roberts, Anthony, & Busick, 2012), data are presented in this format using delta scores.

Overall Results: Control vs. Experimental Groups

Pre- and post analysis of data based on both the SPM and the BASC-2 showed significant improvement. The overall change for the experimental group based on the SPM reflected a 3.71 T score (5.95%) improvement overall; based on the BASC-2, the experimental group's overall change was 6.1 T score (11.9%) improvement. The control group on the other hand reflected no interventions beyond pre-existing work based on IEP goals to the extent that it was being implemented; overall progress represents a .33 point gain on the SPM (2.5%), and 13.5 (1.27%) on the BASC-2, with positive results only in the visual processing and planning categories.Full SPM results are presented in Table 3 and Figure 1; Table 4 and Figure 2 reflect the impact of the interventions as measured by the BASC-2.

Table 3. **SPM Improvements for Experimental and Control Groups Overall**

SPM Category	Control Group		Experimental Group	
	Score	**Percentage Change**	**Score**	**Percentage Change**
Social Participation (SOC)	**-1.52**	**-1.65%**	**7.62**	**11.8%**
Visual Processing (VIS)	**4.00**	**8.20%**	**5.05**	**7.74%**
Auditory Processing (HEA)	**-0.33**	**1.10%**	**4.62**	**7.47%**
Tactile Processing/Touch (TOU)	**-1.19**	**-1.34%**	**1.67**	**2.98%**
Body Awareness (BOD)	**-1.81**	**-1.31%**	**2.05**	**3.43%**
Balance and Motion (BAL)	**-0.62**	**1.89%**	**3.10**	**5.13%**
Planning and Ideas (PLA)	**0.38**	**1.18%**	**4.76**	**7.26%**
Overall	**0.33**	**2.50%**	**3.71**	**5.95%**

Figure 1. **Comparison of Control vs. Experimental Group SPM Results**

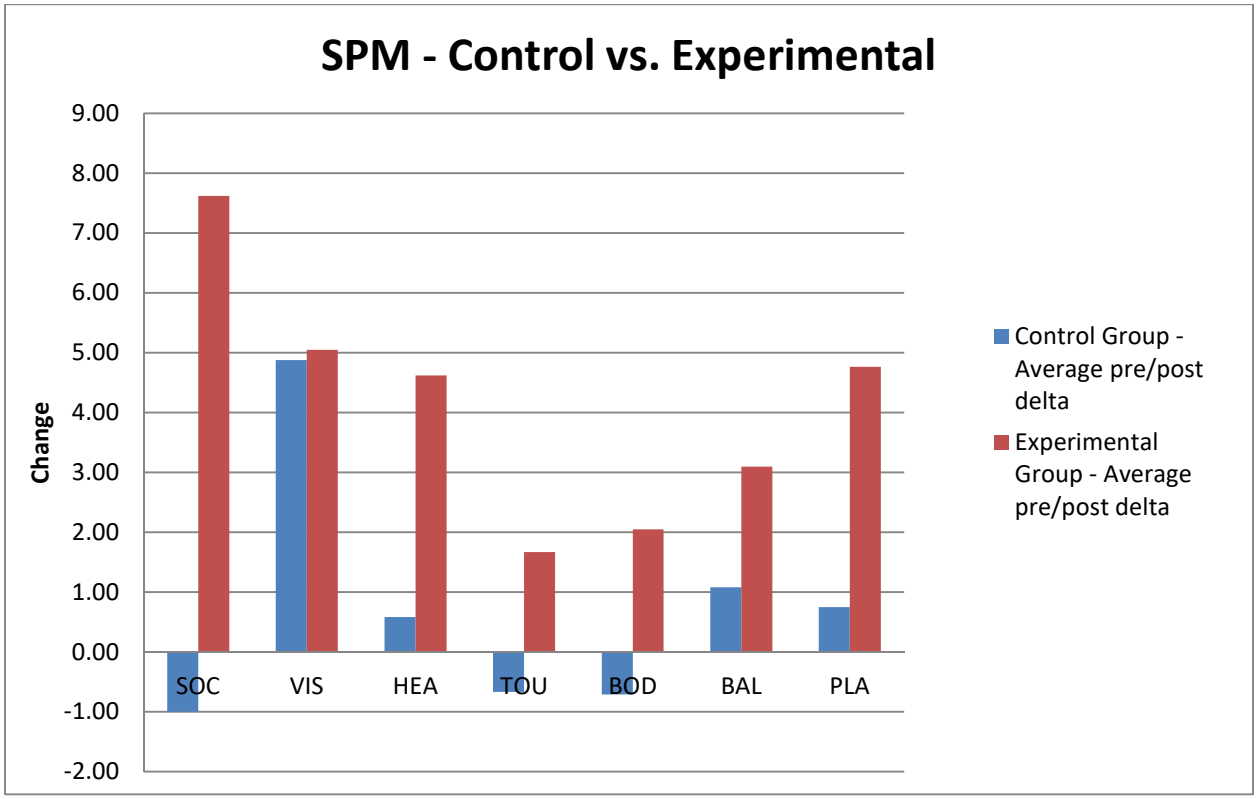
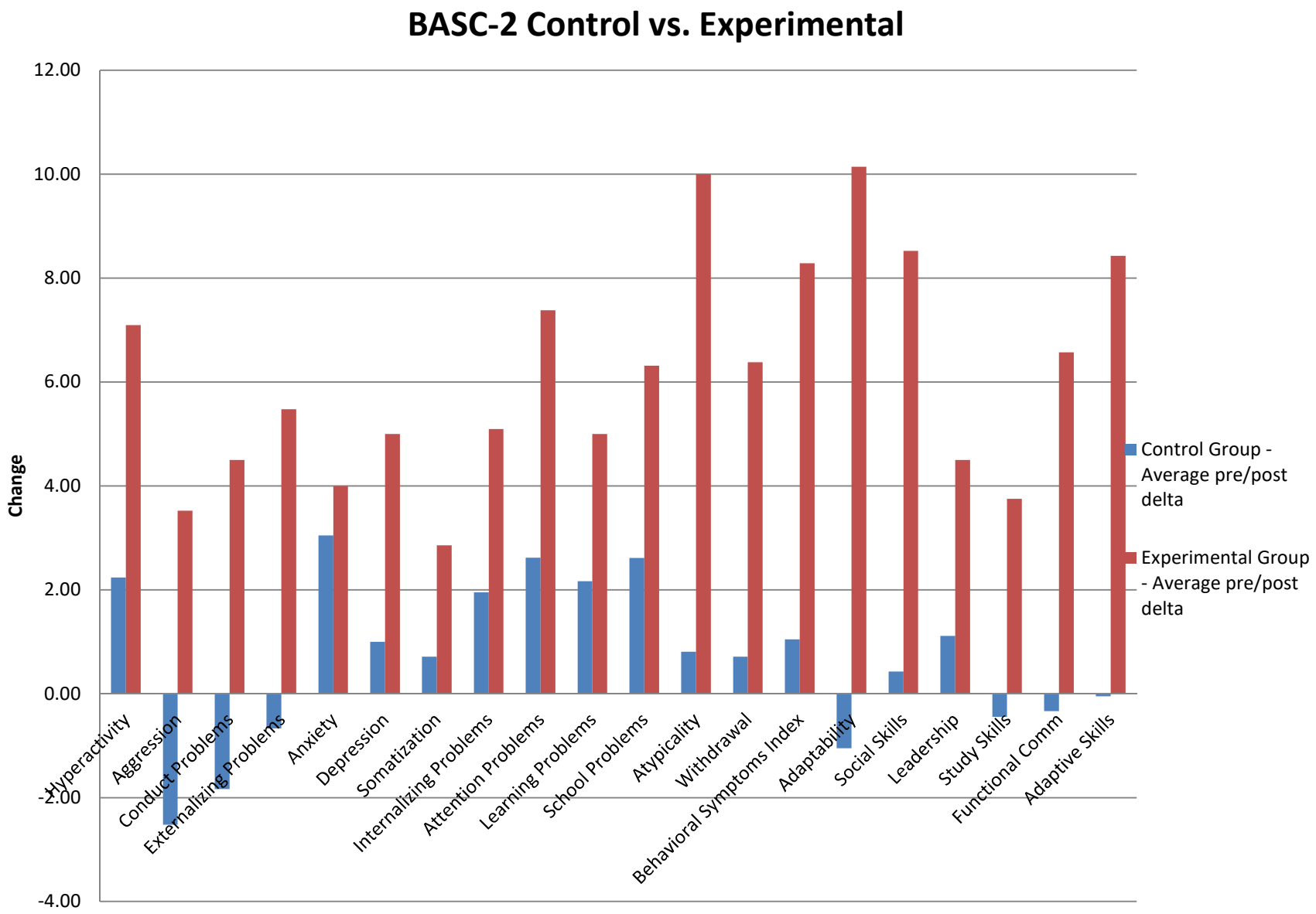


Table 4. **BASC 2: Average Change by Area Measured**

BASC II Category	Control Group		Experimental Group	
	Score	Percentage Change	Score	Percentage Change
Hyperactivity	2.24	3.70%	7.10	10.8%
Aggression	-2.52	-4.93%	3.52	6.5%
Conduct Problems	-1.83	-3.50%	4.50	7.7%
Ext Problems	-0.67	-1.20%	5.48	9.2%
Anxiety	3.05	5.86%	4.00	7.7%
Depression	1.00	1.84%	5.00	8.7%
Somatization	0.71	1.36%	2.86	5.6%
Int Problems	1.95	3.64%	5.10	9.3%
Attn Problems	2.62	4.01%	7.38	11.1%
Learning Problems	2.17	3.16%	5.00	7.6%
School Problems	2.61	3.84%	6.31	9.3%
Atypicality	0.81	1.26%	10.00	14.1%
Withdrawal	0.71	1.16%	6.38	10.4%
Beh Symptoms	1.05	1.69%	8.29	12.6%
Adaptability	-1.05	-2.35%	10.14	24.6%
Social Skills	0.43	1.04%	8.52	22.3%
Leadership	1.11	2.87%	4.50	11.5%
Study Skills	-0.44	-1.16%	3.75	10.0%
Funct Communication	-0.33	-0.94%	6.57	17.4%
Adaptive Skills	-0.05	-0.13%	8.43	22.6%
Overall	13.05	1.27%	6.1	11.9%

Figure 2. **BASC 2: Average Change by Area Measured**



Analysis. Based on the SPM results, the most dramatic area of improvement occurred in the area of social participation. Further detail from the BASC-2 categories pinpoints adaptability and adaptive skills, social skills and functional communication, and atypicality as areas of improvement typically felt to be contributors to social participation. The skills reflected in the social participation category on the SPM include working well with others, handling frustration appropriately, and maintaining eye contact and appropriate personal space. While these are difficult skills for a clinician to address in a traditional therapeutic setting, the classroom environment is ideal as long as sensory modulation is being addressed to promote success in these skills. Similarly, based on the SPM, the experimental group demonstrated improvements in planning by looking at such skills as organization of materials, problem-solving, and sequencing of tasks. Areas of the BASC-2 reflecting areas critical to those skills may include attention and hyperactivity, learning problems and study skills. These pro-social and academic behaviors have a direct impact on classroom participation, and represent significant opportunities for academic gains and successful functioning in a mainstream classroom.

In the area of visual processing, as measured by the SPM, students in both groups demonstrated improvements. This is interesting because it suggests that students exposed to classroom practices may become accustomed to and adjust for the visual processing demands. Similar gains in this area could also be due to the school's Motor Lab. This is based on the *Ready Bodies, Learning Minds* program which strives to enhance learning readiness through specific movement activities that develop the reflex and sensory systems. In the school where this study took place, the Pre-Kindergarten and Kindergarten classes attend the motor lab daily and the first graders attend every other day.

Gains in auditory processing, a frequent challenge for students with sensory issues, were also notable in the experimental group.

As noted above under the section on student cases and validity, these results may be slightly understated due to the student changes in the experimental and control groups.

Impact of Intervention Based on Age of Students

In terms of both measures, the difference in impact between students PK-2 and students in grades 3-6 in the experimental group is notable in most categories. Based on the SPM, social participation and planning are notable according to SPM results for students in grades PK-2. While students in grades 3-6 showed gains in social participation and auditory and visual processing, they showed negative results in other categories. Researchers believe that this is due to less teacher follow-through due to students' frequent classroom rotations. Teacher surveys show that although the homeroom teachers followed through fairly well on the intervention plan, the other teachers demonstrated minimal follow-through. Therefore the students in grades 3-6 received less intervention than kids in pre-K-2. This theory, however, does not explain why the participating students in grades 3-6 improved more than the younger ones on some areas on the BASC-2. It is also possible that the greater improvement seen in the younger grades has to do with the motor lab again; the areas of improvement seen in PreK-2 could be in part due to motor lab which older kids did not experience. Another possibility is that sensory intervention helps most at the sensory system level for younger students and more at the social level for older students. Based on the BASC-2, students in grades 3-6 made gains that actually exceeded those in grades PK-2, most evident in the areas of social skills and adaptability. More research into these questions could help to clarify these issues.

Variables in original level of performance and teacher implementation may further explain this; further investigation of the impact of the intervention in these areas of functioning would be worthwhile. Of the five teachers who work with students in grades 3 and 4, only the two homeroom teachers of the experimental students stated that they taught the BrainWorks analogy and four of the five teachers stated they only used the recommended strategies occasionally or not at all. This means the students in the experimental group in third and fourth grade only had access to the instruction and strategies a portion of their school days. Of the three teachers who taught the sixth graders in the experimental group, one stated she did not teach the BrainWorks analogy or use the tools provided at all and one stated she used the recommended strategies only minimally. Data are presented in the Tables 5 and 6 below.

Table 5. **SPM: Average Change by Area Measured and Age (Experimental Group)**

SPM Category	Overall		Students PK-2		Students Grades 3-6	
	Score	**Percentage Change**	**Score**	**Percentage Change**	**Score**	**Percentage Change**
Social Participation (SOC)	**7.62**	**11.8%**	**8.38**	**12.7%**	**6.38**	**10.4%**
Visual Processing (VIS)	**5.05**	**7.74%**	**7.00**	**10.7%**	**1.88**	**2.9%**
Auditory Processing (HEA)	**4.62**	**7.47%**	**6.08**	**9.0%**	**2.25**	**4.2%**
Tactile Processing/Touch (TOU)	**1.67**	**2.98%**	**3.08**	**5.0%**	**-0.63**	**-1.3%**
Body Awareness (BOD)	**2.05**	**3.43%**	**4.85**	**7.5%**	**-2.50**	**-4.9%**
Balance and Motion (BAL)	**3.10**	**5.13%**	**5.54**	**8.6%**	**-0.88**	**-1.6%**
Planning and Ideas (PLA)	**4.76**	**7.26%**	**8.38**	**12.4%**	**-1.13**	**-1.8%**
Overall	**3.71**	**5.95%**	**6.00**	**9.1%**	**0.00**	**0%**

Table 6. **BASC 2: Average Change by Area Measured and Age (Experimental Group)**

BASC II Category	Overall		Students Grades PK-2		Students Grades 3-6	
	Score	Percentage Change	Score	Percentage Change	Score	Percentage Change
Hyperactivity	7.10	10.8%	7.50	12.2%	5.38	8.4%
Aggression	3.52	6.5%	2.43	4.6%	5.25	9.5%
Conduct Problems	4.50	7.7%	5.00	8.5%	3.88	6.9%
Ext Problems	5.48	9.2%	5.36	9.3%	5.25	8.9%
Anxiety	4.00	7.7%	5.71	10.1%	1.38	2.9%
Depression	5.00	8.7%	6.86	11.1%	2.00	3.9%
Somatization	2.86	5.6%	5.07	7.8%	0.63	1.3%
Int Problems	5.10	9.3%	7.57	12.2%	1.63	3.4%
Attn Problems	7.38	11.1%	9.07	13.9%	4.13	6.4%
Learning Problems	5.00	7.6%	10.67	14.2%	0.38	0.6%
School Problems	6.31	9.3%	10.56	14.7%	2.38	3.6%
Atypicality	10.00	14.1%	12.79	16.7%	5.38	8.9%
Withdrawal	6.38	10.4%	9.07	14.0%	2.13	3.8%
Beh Symptoms	8.29	12.6%	10.14	15.0%	4.88	8.0%
Adaptability	10.14	24.6%	8.57	22.0%	11.25	29.2%
Social Skills	8.52	22.3%	6.93	18.2%	10.25	30.6%
Leadership	4.50	11.5%	4.25	10.6%	4.75	12.3%
Study Skills	3.75	10.0%	4.88	12.6%	2.63	7.2%
Funct Communication	6.57	17.4%	7.0	17.3%	5.88	17.7%
Adaptive Skills	8.43	22.6%	8.7	22.4%	7.88	23.1%
Overall	6.1	11.9%	8.46	17.3%	6.63	16%

The most significant variable between the two age groups is that students in PK- first grade are together with the same teacher throughout the day and second graders change teachers only once per day. Thus, the teacher is positioned to conduct interventions systematically and consistently. The older students change classrooms and teachers according to subject matter; thus

one or some of their teachers implemented the program during their contact time, but other teachers throughout the day did not. Understandably, the results reflected this variability of approach.

In the next section, we will examine teacher approaches more closely to identify, within each group, the practices of teachers where gains were more notable, focusing specifically on how and when they implemented sensory interventions and movement breaks in order to pinpoint more effective practices for future teachers adopting this intervention model.

Teacher Implementation

Examining the data on teacher averages, the age/grade discrepancies are evident. Teachers of grades PK-2 in the experimental group saw much greater changes than did those of students in grades 3-6, in both the SPM and BASC-2 measures, particularly Teachers 1, 2, and 3; the gains on both measures were relatively consistent. On the BASC-2, however, students working with Teachers 5 and 7 also showed gains; these gains were not matched by corresponding progress measured by the SPM. This may be explained by the fact the SPM is measuring true sensory processing while the BASC-2 is measuring behavioral outcomes. Because neuroplasticity is believed to decrease with age, it may be more difficult to make true gains in actual processing as a person ages, but the strategies may still be beneficial from a behavioral standpoint. The better results on the BASC-2 for the older children could indicate that even though the underlying issues are still present, the students benefit behaviorally from having appropriate strategies in place. The overall discrepancy by grade level suggests that structure and contact time are important, and it is likely that all members of a student's teaching team would require training to implement a systematic approach for a student changing teachers and classes

throughout the day, as do those in Grades 3-6. Table 7 displays results by teacher and grade level of teachers in the experimental group.

Table 7. **Results of Intervention by Teacher and Grade Level**

Teacher	Grade	Average SPM change	Average BASC 2 Change
Teacher 1	Pre-K	5.05	6.67
Teacher 2	K	7.05	10.5
Teacher 3	1	9.14	12.25
Teacher 4	2	2.52	3.17
Teacher 5	3-4/writing	-0.64	8.13
Teacher 6	3-4/social studies	2.79	2.25
Teacher 7	6/LA	1.57	8

In order to determine factors that both enhanced and limited success, we looked further at initial impact of training, implementation, and the teachers' own reported experiences ("teacher feedback"). Table 8 below summarizes teacher interventions. First, regarding the number and percentage of strategies used (Column 3 in Table 8), during the training, teachers were provided with a customized list of all of the sensory strategies recommended for each student based on his SPM results. On the post-intervention survey, teachers rated each strategy 1-5. If they rated it a 4 or 5, it was considered as a "successful strategy." The total number of successful strategies represents the total number of recommended strategies for all students that the teacher worked with.

All the teachers reported experiencing success with at least half of the recommended strategies. Within the group of PK-2 teachers, all those in the experimental group reported that they had taught the BrainWorks Analogy – that students could determine and control their level of alertness and choose activities to self-regulate. While there was not necessarily a correlation

between students' understanding of the analogy or the number of recommended strategies that teachers used successfully, the teacher with the highest gains did report that all of her students did use the BrainWorks tool to determine their own needs. This is a significant accomplishment for a child in this age range. The mere fact of offering choices and strategies, however, may be more significant.

Table 8. **Teacher implementation data, Experimental Group**

Teacher	Grade	# of Recommended Strategies Successful	% of Recommended strategies successful	Teach BW Analogy	Students Understand BW Analogy	% of Students Understanding BW Analogy	Average SPM change	Average BASC 2 Change
Teacher 1	Pre-K	16/18	88.9%	Yes	2 of 3	66.7%	5.05	6.67
Teacher 2	Kindergarten	13/23	56.5%	Yes	1 of 3	33.3%	7.05	10.5
Teacher 3	Grade 1	22/34	64.7%	Yes	4 of 4	100%	9.14	12.25
Teacher 4	Grade 2	13/22	59.1%	Yes	2 of 3	66.7%	2.52	3.17
Teacher 5	Grades 3&4	11/42	26.2%	Yes	5 of 6	83.3%	-0.64	8.13
Teacher 6	Grades 3&4	9/42	21.4%	Yes	6 of 6	100%	2.79	2.25
Teacher 7	Grade 6	10/14	71.4%	Yes	2 of 2	100%	1.57	8

Within the group of Teachers 1-4 – who had contact with their students throughout the school day - the percentage of strategies used does seem to have affected outcomes. However, Teacher 4's outcomes are less than that of Teacher 2, who reported using fewer strategies successfully. All four of the PK-2 teachers did use the BrainWorks tool, and the teacher whose students achieved the greatest gains reported that all students demonstrated understanding of the tool. Within the group, Teacher 2 and Teacher 3 experienced far greater impact in their

implementation than did Teachers 1 and 4; for this reason, we examined more closely the approaches of Teacher 3, whose students demonstrated the greatest gains, to those of Teacher 4 whose students made fewer gains as a result of the program. Table 9 below provides greater information on teacher implementation in order to draw distinctions among the teachers of students in grades PK-2 who experienced the greatest and least impact of the changes (Table 9).

At first glance, both Teacher 3 and Teacher 4 reported positive results with increasing their awareness of sensory processing as a way to enhance student performance. Both teachers incorporated daily movement breaks; both used the BrainWorks Tachometer and folders to provide students with tools to monitor their sensory equilibrium and to allow them choices in their sensory break activities. Both also reported overall benefits to their students. The order of magnitude, however, differed significantly between the two.

The greatest difference reported in implementation between Teacher 3 and Teacher 4 is in the use of Sensory Breaks, with Teacher 3 building them into the class schedule and Teacher 4 relying on them on an "As Needed" basis. This is significant for two primary reasons. First, children with sensory processing difficulties are often weak in self-regulation and self-monitoring skills; thus, noting a need is probably outside of their capabilities. If the breaks were not based on student request, it relied on teacher observing behaviors when they got to the level of problematic. Teacher 3, on the other hand, met student needs proactively, which likely contributed to more extended self-regulation of students, i.e., taking the breaks before students lost control, and also provided structure and regularity in the schedule, which is an accommodation useful for many students with sensory processing differences. This difference may pinpoint a need for future trainings: to emphasize the need for teacher scheduling of

proactive sensory breaks, rather than awaiting a manifest need presented in the form of student dysregulation (Table 9).

Of the strategies recommended, movement breaks, preferential seating near the teacher, Kore Wobble Chairs, FootFidget® Footrests, and weighted lap pads were the most consistently recognized as being useful to the students based on teacher surveys. Finger fidget toys were identified as being the least helpful, with many teachers stating they caused problems much more than they helped.

Table 9. Comparison of Lower Elementary Teacher Implementation Summary

Teacher	Average Change	Teacher feedback on experience	Teacher feedback on movement breaks	Teacher feedback on sensory breaks	USE of Brainworks Tools	Overall notes
Teacher 3: More gains	SPM: 9.14 BASC 2: 12.25	Participation in this program greatly increased my awareness of sensory processing issues in the classroom.	Short movement breaks were regularly provided in my classroom every 15-45 minutes. While in my class, the students participated in this type of movement break daily.	Sensory breaks were built into our schedule for the assessed students.	I used the BrainWorks tachometer as a teaching tool. Students used the BrainWorks File Folder Tool to select activities based on their sensory needs. Students referred to the colored arrows on the BrainWorks activity cards to select appropriate sensory activities.	The overall atmosphere in my classroom seems to be a more positive one. I have noticed a difference in my performance and focus as well. I try to do as many of the breaks with the students as possible.
Teacher 4: Fewer gains	SPM: 2.52 BASC 2: 3.17	Participation in this program greatly increased my awareness of sensory processing issues in the classroom.	Short movement breaks were regularly provided in my classroom every 15-45 minutes. While in my class, the students participated in this type of movement break daily.	The students were allowed individualized "sensory breaks" on an as-needed basis.	I used the BrainWorks tachometer as a teaching tool. Students used the BrainWorks File Folder Tool to select activities based on their sensory needs.	Teachers need to be open minded about using sensory tools. They really do work and many of my students benefitted from them. Sensory strategies make a big difference in my classroom! This study was helpful for me in so many ways. Not only did I learn how to help my students, but the impact it made was really incredible.

There is also a discrepancy among teachers in the higher elementary grades, who saw their students for only a few hours per day. Teachers 5 and 7 reported relatively high gains in the BASC-2 results, although Teacher 5 used only 26.2% of the strategies successfully and Teacher 7 employed 71.4%. Both reported high rates of students' understanding of the BW analogy (83.3% and 100% respectively), although Teacher 6, whose gains were lower, also reported 100% of understanding. It is noteworthy that all four students in Teacher 6's homeroom showed minimal deficit areas on both assessment tools. In fact, the total scores for all four of these students put them in the "typical" range on the SPM. This could indicate that the problematic areas seen on the BASC-2 are less likely to be rooted in sensory processing issues. As all 3 were the homeroom teachers of the participating students, further analysis of these teachers' implementation notes also follows in Table 10.

In terms of implantation, however, among the teachers of higher elementary grades, there were few differences. Sensory breaks for all were "as needed", so this does not seem to explain the differences in results; use of BrainWorks tools also was parallel among these teachers. The only difference among them seems to be that Teacher 5 scheduled regular movement breaks every 15-45 minutes; others reported regular use but not on the 15-45 minute schedule. Table 10 displays the results.

Table 10. Comparison of Upper Elementary Teacher Implementation Summary

Teacher	Avg Change	Teacher feedback on experience	Teacher feedback	Teacher feedback on sensory breaks	USE of Brainworks Tools	Overall notes
Teacher 5: More gains	SPM: -0.64 BASC 2: 8.13	Participation in this program greatly increased my awareness of sensory processing issues in the classroom.	Short movement breaks were frequently provided in my classroom every 15-45 minutes.	The students were allowed individualized "sensory breaks" on an as-needed basis. Sensory strategies are worthwhile for some students.	I used the BrainWorks activity cards regularly for movement breaks choices. Students used the BrainWorks key ring tool to select activities based on their sensory needs.	The program would be easier to implement for a self-contained classroom. Some of my classes were broken up by P.E. and/or Specials, which I considered an extended break. Only one of the study groups were in the classroom for a full 50 minutes, and that group was allowed more freedom of movement during the entire class period (as long as work continued and was completed). I feel that some modeling of the program in a classroom setting on video would have been helpful. I would have liked more help with setting up the individualized part of the program.
Teacher 7: More gains	SPM: 1.57 BASC 2: 8.0	Participation in this program greatly increased my awareness of sensory processing issues in the classroom.	Short movement breaks were frequently provided in my classroom but not every 15-45 minutes.	The students were allowed individualized "sensory breaks" on an as-needed basis. Sensory strategies make a big difference in my classroom!	I used the BrainWorks activity cards regularly for movement breaks choices. For 6th Grade, I think the main thing that helps is teaching them to recognize when they need a Brain Break, different ways to handle it, and the use of the stools. I think self-regulation should be taught. I would be interested in info/materials that target older students on self-regulation.	I think the study was worthwhile and beneficial to our students. I saw several really "get" their need for it.
Teacher 6: Fewer gains	SPM: 2.79 BASC 2: 2.25	Participation in this program greatly increased my awareness of sensory processing issues in the classroom.	Short movement breaks were frequently provided in my classroom but not every 15-45 minutes.	The students were allowed individualized "sensory breaks" on an as-needed basis. Sensory strategies are worthwhile for some students.	Students used the BrainWorks key ring tool to select activities based on their sensory needs. I think it is a good program. It does help some where others it didn't do much but distract them.	I feel like any long period of work should be broken up. It helps students to not wander and get back focused on their work.

Discussion and Conclusion

While not generalizable, this study provides evidence in the context of one school district of the impact of a classroom-based sensory program for teachers and students. The classroom improvement gains demonstrate the importance of including this type of approach so that students are able to better focus on their developmental and academic learning. Previous studies in clinical settings have shown similar improvements, but incorporating sensory strategies for student self-regulation in a school setting is relatively new.

It is evident that further research in this area is needed. Given the importance of student outcomes, progress toward IEP and academic goals, and overall well-being within an educational environment, expanding the use of such training and use of systematic approaches can benefit students and teachers alike. Most importantly, this supports teacher efforts to develop effective strategies in order to support their students as they achieve their potential. Moreover, by targeting student awareness, such student-centered tools provide them with the awareness of how to improve their own self-regulation. Thus, as they progress through the school system, the habits of self-regulation will become instilled, enabling students to take control of their own performance and improve their academic outcomes. This will benefit not only the students, but teachers and schools, as student academic progress contributes to the overall success rate and outcomes of schools.

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[2] According to APA Guidelines, while retrievability of data sources is essential, the ethics of participant confidentiality outweigh this principle. Given the small size of the district, with only one elementary, middle, and high school, district names have been redacted, both in text, and in citations. Original documents remain in hard copy with researchers. Source: http://blog.apastyle.org/apastyle/2013/08/lets-talk-about-research-participants.html