

A Quasi-Experimental Design Determining the Effectiveness of Dynamic Seating on  
Classroom Off-task Behaviors

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JESSICA EGGLESTON

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Approval Page

A Quasi-Experimental Design Determining the Effectiveness of Dynamic Seating on  
Classroom Off-task Behaviors

By

Jessica Eggleston, Ed.D

Approved by:

Candace Mazze Ed.D Sept 7 2017  
Chair: Candace Mazze, Ed.D. Date

Certified by:

John E. Neal 9/8/2017  
Dean of School : John Neal, Ed.D Date

## Abstract

Elementary students spend an average of five and a quarter hours per day seated on a hard surface which provides little sensory input and possibly contributes to discomfort. Sensory integration was found to improve executive functioning skills in elementary students by helping their comfort level at being seated. This quasi-experimental study sought to explore how the type of seating offered to a student can affect student on-task behavior, which means fewer off-task behaviors in the classroom and greater attention to academic performance. Baseline data were collected on student off-task behaviors and used to compare to post intervention data using the same student disruption qualifiers. The total count of student off-task behaviors was defined as inappropriate out of seat behavior, fidgeting in a way that disturbs the learning environment, and/or blurting out of turn. The quasi-experiment was intended to start six weeks from the start of school, however, due to limitations out of this researcher control the study began 24 weeks from the first day of school. Frequency data were collected on the number of off-task behaviors that occur daily. Off-task behaviors were counted and totals were recorded each hour of the day. These numbers were added and counted as baseline data. After the introduction of the air-filled disks in the student chairs, data were collected to quantify the number of off-task behaviors that occur daily by the hour. These numbers were added to compare to pre-intervention data using a one-way repeated analysis of variance (ANOVA) which showed a significant difference in off task behaviors with a .426 Partial Eta Squared value which shows statistical significance to reject the null hypothesis. The intended sample size was 45 fourth graders with 23 in a controlled environment and 22 in the experimental environment. However, due to acquiring parental consent the total

numbers were nine in the control classroom and 17 in the experimental classroom. This research hoped to positively correlate dynamic seating with increased academic scores and decreased off-task behaviors. The findings showed the air-filled disk provided enough proprioceptive input to decrease off-task behavior and improve academic scores.

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## Chapter 1: Introduction

The average elementary student spends 943 hours per year in the classroom seated on a hard surface during the instructional day (Jaggi, Bakhshi, & Sandhu, 2013; OEDC, 2013). Educators have changed how they deliver the learning material; however, there have been no modifications on the seating environment within the school (Jaggi et al., 2013). Children need movement in order to organize their thoughts as information is given (Schaaf, Benevides, Mailloux, Faller, Hunt, van Hooydonk, & Kelly, 2014). Recess has become a superfluous activity in many schools, which decreases outdoor time for student movement (Lorenzo & Lorenzo, 2013). Decreased recess paired with the increased use of technology equates to students spending more time in a seated position on a hard surface and less time running and jumping outdoors (Jaggi et al., 2013). Academic instructional strategies have increased in the past century with better understanding of how students learn; however, the United States still ranks 27 out of 34 in mathematics and 17 out of 34 in reading (OEDC, 2013).

Lack of outdoor time equates to lack of movement for students who are now required to remain seated within the classroom on a hard surface for longer periods of time (Jaggi et al., 2013). A common complaint among teachers includes off-task behavior and classroom off-task behaviors (Oliver, Wehby, & Reschly, 2011). Despite the best professional development provided on research based strategies for classroom management, students are still performing with less accomplishment than other countries in reading and mathematics (OEDC, 2013). As teachers struggle to meet the demands of testing, curriculum requirements, and behavior management, it is time to explore other possibilities to improve learning (Algozzine, Wang, White, Cooke, Duran, & Marr,

2012). As the educational community has the best instructional strategies and evidence based behavior management approaches, perhaps it is time to explore environmental changes involving how students are seated within the classroom (Eisenman, Edwards, & Cushman, 2015).

School-aged children are not only dealing with learning new material and navigating the social contingencies of fitting into the culture of their school, students also struggle with environmental issues that may affect learning (Burgoyne & Ketcham, 2015). Some students struggle with emotional and physical self-regulation. Emotional self-regulation focuses on impulsiveness and aggression while physical self-regulation focuses on the need for movement and a student's ability to be successful despite too much or too little sensory input (Cheng, Auerbach, Hunt, Chang, Pusic, Nadkarni, & Kessler, 2014; Schaaf, Benevides, Mailloux, Faller, Hunt, van Hooydonk, & Kelly, 2014).

## **Background**

Despite having a plethora of classroom management strategies in place, some teachers still find many students are unable to refrain from off-task behaviors (Oliver et al., 2011). Certain environmental conditions may be contributing factors in self-regulation issues for students. Classroom design has been relatively the same for over 60 years (Boyd, Conroy, Asmus, & McKenney, 2011). Students have been seated on hard surfaces and faced a board almost since the beginning of public education. The chairs have changed from wood to plastic in most cases (Boyd et al., 2011). Boyd, Conroy, Asmus, and McKenney (2011) state the board in the classroom has changed from a black or green to a white board. What is on those boards have also changed (Boyd et al., 2011).

Prior to the introduction of technology, the boards in the classroom were static.

Classrooms are highly integrated with technology which means the information on the board moves (Safitry, Mantoro, Ayu, Mayumi, Dewanti, & Azmeela, 2015). This includes Smart Boards ®, projectors, iPads, computers, and VCR/DVD players (Safitry et al., 2015). The board information moves, but the students do not.

Students also struggle with many internal and external factors, which affect their learning. Internal factors that impede learning can include anxiety, social awkwardness, psychosomatic illnesses, depression, and inability to concentrate (Pentland, Maciver, Owen, Forsyth, Irvine, Walsh, & Crowe, 2016). External factors that impede learning can include physical and/or verbal aggression, destruction of the classroom, elopement, and other dangerous behaviors (Pentland et al., 2016). Many of these conditions are symptoms of the major disabilities in the general education classroom. These are (a) sensory processing disorder, (b) mental health issues, (c) attention deficit disorder, and (d) learning disabilities. Sensory Processing Disorder (SPD) affects approximately 5-17% of the student population (Ben-Sasson et al., 2014; Pentland et al., 2016; Schaaf et al., 2014). The Center for Disease Control (CDC, 2013) reports approximately 13-20% of the student population is dealing with mental disorders, and 11% is affected with Attention Deficit Hyperactive Disorder (ADHD). Finally, children with Learning Disabilities account for approximately 5% of the school population (Ben-Sasson, Carter, & Briggs-Gowan, 2010). General education teachers are seeking interventions to assist all learners in their classrooms in behavioral and academic endeavors.

## Statement of the Problem

Despite teachers with superior skills in classroom management, off-task behaviors still exist (Algozzine et al., 2012). Childhood behavioral concerns and increasing numbers of childhood disorders like learning disabilities and ADHD are cited as two reasons for off-task behavior (Oliver et al., 2011). Off-task behavior consists of any behavior that stops the learning process for the student or impedes the learning of others (Oliver et al., 2011). Reviews of literature suggests off-task behavior has been increasing since 2000 (Jacobsen, 2013; Oliver et al., 2011; Pfeiffer, Koenig, Kinnealey, Sheppard, & Henderson, 2014). The static condition of chair components of the classroom ecosystem may contribute to off-task behavior among students since outdoor time has decreased in the same time-frame (Pfeiffer et al., 2014; Smith-Roley et al., 2015).

The school ecosystem has changed dramatically since the 1970's with the introduction of technology, which has the capability to change rapidly. The one item that has not changed in the last fifty years is the type of seating provided for students. Current seating does not provide an outlet for proprioceptive movement as students have to shift and move on a hard-uncomfortable surface. Proprioception is a complex system involving the muscles, ligaments, and joints and is hypothesized to have an impact on behavior regulation (Block & Weatherford, 2013). The addition of dynamic seating allows students to integrate movement of muscles, ligaments, and joints and provide proprioceptive input (Pfeiffer et al., 2014). This provision of movement may increase mindfulness to task and decrease wandering attention or off-task behavior (Pfeiffer et al., 2014). Exploring dynamic seating arrangements allowed this researcher to compare

academic scores and off-task behaviors in fourth grade students in a pre and post experimental design.

Only a few researchers have conducted research on the addition of dynamic seating as a way to increase academic achievement and decrease off-task behaviors due to the students' need to move (Smith-Roley et al., 2014). Most research has focused on the use of stability balls to provide proprioceptive input for students (Block & Weatherford, 2013). Stability balls come with a few inherent problems: cost per student and storage (Block & Weatherford, 2013). Several researchers have begun to study the use of air-filled disks which are one third the cost and storage is minimal (Burgoyne & Ketcham, 2015). This research can contribute to the air-filled disk studies comparing the air-filled disk to static seating.

### **Purpose of the Study**

The purpose of this quantitative quasi – experimental study was to determine if the addition of dynamic seating to standard static chairs would provide enough proprioceptive input to increase on task behavior. Dynamic seating known as air filled disks in this study were provided by the researcher purchasing the items out of their own personal budget. Burgoyne and Ketcham (2015) found the introduction of dynamic seating into the classroom will engage student sensory systems in a way that allowed boys and girls to stay on task and decrease off-task behaviors. Dynamic seating systems previously studied have included air-filled disks (Pfeiffer et al., 2014; Wang et al., 2014), stability balls (Burgoyne & Ketcham, 2015; Fedewa et al., 2011; Schult et al., 2014) and sit to stand desks (Clemes et al., 2015; Commissaris et al., 2014). Businesses are beginning to seek alternative seating approaches to increase productivity as well

encourage the employees' physical health (Zemp, Taylor, & Lorenzetti, 2013). Prolonged periods of sitting are attributed to early mortality risks (van der Ploeg, Chey, Korda, Banks, & Bauman, 2012).

The secondary purpose of this study was to determine the effectiveness of adding dynamic seating as a means of providing proprioceptive movement to increase academic achievement and decrease off-task behaviors in a suburban fourth grade general education classroom located in the Midwest. The study was conducted in two fourth grade classrooms; one in which seats had dynamic seating installed in seats, the other had traditional hard seating. The participating classroom teachers each used a grid with randomly assigned student numbers to record grades and instances of off-task behavior within the fourth-grade classrooms. Grades were recorded daily in reading, writing, and math. Reading scores focused on the percent of correct comprehension responses. Math scores focused on the percent of correct calculations in daily work. Writing scores that were recorded were based on the district rubric of six traits of writing. Off-task behaviors were measured with tallies per student when off-task behaviors to learning occur.

The statistical test of a one-way repeated measure ANOVA was used to determine the effectiveness of dynamic seating on off-task behavior. A power analysis conducted on the use of 22 students in the experimental group versus the 23 students in the control group found a medium effect size. Baseline data were collected for three weeks. Baseline data are data that are collected prior to the introduction of the treatment. The experimental and control classrooms followed the same protocols for data collection. After three weeks of data collection at the baseline level, the experimental classroom received air-filled disks which were added to their static chairs. The desks were properly

adjusted to allow for the extra two inches in seat height provided by the air-filled disks. After a one-week introduction, data collection began again for both the experimental and control groups. Data was collected for six weeks and compared to baseline data for each student in the experimental group and tabulated across the nine weeks of data collection for the control group.

### **Research Questions**

This study of suburban fourth grade students in a Midwest school sought out to explore how the type of seating offered to a student can affect on-task behavior and academic performance. In many school districts, recess and physical education have been decreased causing students to spend even more time sitting on a hard surface in order to learn (Schaaf et al., 2014). Utilizing district scoring guidelines for reading, math, and writing as an analysis tool of pre and post comparison for academic achievement and tallies derived from videotaping the classrooms for off-task behaviors, a comparison of baseline and intervention data were tabulated. Inter-observer reliability was utilized by cross viewing probes of the control and experimental classroom videotapes. A reliability score of  $p \geq .80$  was sought. The following research questions were used to guide the quantitative study in determining if the type of seating offered to a student can decrease or increase student on-task behavior and academic performance.

**Q1.** What difference, if any, exists in off-task behavior between fourth grade students who are seated on a dynamic air-filled disk versus a static hard plastic chair?

**Q2.** What difference, if any, exists in academic achievement between fourth grade students who are seated on a dynamic air-filled disk versus a static hard plastic chair?

### **Hypotheses**

**H1<sub>0</sub>.** There will be no significant difference in off-task behaviors of fourth grade students seated on air-filled disks after previously being seated on hard plastic chairs versus students who continue to be seated on hard plastic chairs.

**H1<sub>a</sub>.** There will be a significant difference in off-task behavior between fourth grade students seated on air-filled disks after previously being seated on hard plastic chairs versus students who continue to be seated on hard plastic chairs.

**H2<sub>0</sub>.** There will be no significant difference in academic performance between fourth grade students seated on air-filled disks after previously being seated on hard plastic chairs versus students who continue to be seated on hard plastic chairs.

**H2<sub>a</sub>.** There will be a significant difference in academic performance between fourth grade students seated on air-filled disks after previously being seated on hard plastic chairs versus students who continue to be seated on hard plastic chairs.

### **Nature of the Study**

The purpose of this quantitative quasi – experimental study was to determine if the addition of dynamic seating to standard static chairs provided enough proprioceptive input to decrease classroom off-task behaviors. This was a natural quasi-experiment due to the nature of classroom assignments and availability of students. A quasi-experimental group means the group assignment is not random in the traditional experimental type of design as the students were all fourth graders from the same economic background (Derue, Nahrang, Hollenbeck, & Workman, 2012). A qualitative method would use narrative responses based on the opinion of others (Berg & Lune, 2012). In this scenario, the others would be students. Student opinion would not have been sufficient for measuring the outcome of environmental design on decreasing inappropriate behaviors

(Sargeant, 2012). Perception is not an accurate descriptor on the effectiveness of this intervention on the classroom.

This study addressed a simple intervention that, as found within existing research, educators can use as a potential means of minimizing classroom off-task behaviors that can impede learning. Educators can fulfill their idea of using dynamic seating by asking for a grant or using websites that allow for donations. A control group of fourth grade students at the same location were used for comparison. The purpose of this quantitative quasi – experimental study was to determine if the addition of dynamic seating to standard static chairs provided enough proprioceptive input to decrease classroom off-task behavior and increase academic performance. From this study, educators may be able to validate the need for air-filled disks using this research-based intervention when applying for grant requests within their schools. It is hoped this study would contribute to research for educators to look for meaningful ways to benefit all needs of their students.

### **Significance of the Study**

Many educators have chosen to use stability balls as a means of increasing movement in the classroom with significant results (Schult et al., 2013). However, there are cons of using stability balls:(a) balls rolling away when students get up, (b) storage when not in use, (c) overstimulation as some students really bounce on them, and (d) rolling balls makes it difficult for the custodial staff to clean the room (Fedewa & Erwin, 2011). Fedewa and Erwin (2011) found significant improvement in academic achievement with the use of air-filled disks as they do not pose potential problems with storage, over stimulation, or movement when students rise. The chairs can still be placed on top of the desk for cleaning which were appealing to custodial staff (Fedewa & Erwin,

2011). Furthermore, when the students get out of their seat, the cushion stayed in the chair causing less disruption in the classroom (Fedewa & Erwin, 2011) Finally, students are less likely to overstimulate on the chair cushion because the buoyancy is not as high as the stability balls (Burgoyne & Ketcham, 2015). A correct hypothesis would indicate a simple solution for classroom teachers to ameliorate disruptions in the classroom.

The external movement of doing two things at once is called fidgeting, and it increases retention of material by as much as 39% (Farley, Risko, & Kingstone, 2013; Rotz & Wright, 2013). Fidgeting is most effective when it uses a sense that is not required by listening. Allowing students to sit on dynamic seating showed significant statistical differences in attention to task compared to being seated on static chairs (Pfeiffer et al., 2014; Schwabova, Maly, & Zahalka, 2015). Students who are seated on dynamic seating are less likely to seek sensory input by moving about the room, blurting, or being off-task (Smith-Roley et al., 2015). The hypothesis of this research was that grades would improve and classroom off-task behaviors would decrease. If this study was not conducted, students would continue to be seated on static chairs. This study was a unique opportunity to improve the quality of seating provided to students by changing the ecosystem of the classroom (Schwabova, Maly, & Zahalka, 2015).

### **Definition of Key Terms**

**Dynamic seating.** Dynamic seating provides proprioceptive input through the ability to move (Schwabova, Maly, & Zahalka, 2015).

**Inattentiveness.** Inattentiveness is the Inability to focus attention on task at hand (Burgoyne & Ketcham, 2015).

**Off-task Behaviors.** An off-task behavior is classified as any behavior in the classroom that interrupts the learning environment or impedes the learning of others (Algozzine et al., 2012).

**On-task behavior.** On-task behavior is a completion of a task as directed by authority (Oliver et al., 2011).

**Proprioceptive input.** Proprioceptive input is movement that allows the person to have body awareness in time and space through sensations from joints, muscles, and connective tissues (Smith-Roley et al., 2015).

**Static seating.** Seating that does not move or give allowances for movement (Smith-Roley et al., 2015).

## **Summary**

The purpose of this quantitative quasi – experimental study was to determine if the addition of dynamic seating to standard static chairs provided enough proprioceptive input to decrease classroom off-task behaviors. Disruptive behavior is one of the main reasons for off-task behavior (Algozzine et al., 2012). Despite teachers with high skills in classroom management, classroom off-task behaviors still exist. For the purpose of this study, off-task behaviors were defined as any behavior that is conveyed in a manner that is disruptive to learning. The researcher used a grid with student numbers and made tallies as off-task behaviors occurred. This was then entered into an excel spreadsheet for analysis. All students in the experimental class received the dynamic seating intervention. Baseline data were collected before the introduction of the dynamic seating. Baseline data are data which were collected prior to an intervention. This allowed the researcher to make analyses for the experimental classroom between pre and post intervention data.

Baseline data of the grades of core subjects and classroom off-task behaviors were collected and compared before and after the introduction of dynamic seating to the standard classroom chair. These data were compared to the control classroom which had no environmental changes; however, the same behaviors and grades were collected. This determined the effectiveness of the dynamic seating on academic and behavioral conditions when used with fourth grade students.

## Chapter 2: Literature Review

The purpose of this quantitative correlational study was to determine the effectiveness of implementing proprioceptive movement for fourth grade students through air-filled disks and their relationship with on-task behavior. The literature review employed research and theory in the topics of movement needs of children, brain function, physical health as it relates to learning, and on-task behavior in the classroom. This literature review will discuss the barriers found in previous research and address current needs. The problem is the sedentary lifestyle promoted by the current structure of the elementary school day which contributes to a lack of proprioceptive movement for children (Fede, 2012). Besides the lack of movement built into the school day, students are moving less in their out of school time due to increased engagement in technology (Jaggi, Bakhshi, & Sandhu, 2013). Researchers are finding children exceed the recommended two hours of screen time per day and are spending as much as five hours a day in leisure activities that involve sedentary screen activities rather than physical activity (Smedegaard, Christiansen, Lund-Cramer, Bredahal, & Skovgaard, 2016).

Student screen time has been reported to increase attentional problems, academic and behavioral difficulties, disorders in eating and sleeping, and early onset obesity (American Academy of Pediatrics, 2016). Researchers note with the recent increase in technology use, it could be years before other long-term effects are documented (Smedegaard et al., 2016). Increased screen time, paired with decreased physical activity at school equates to more off-task behavior which decreases academic achievement (Jaggi et al., 2013). Students need to engage their inner-core during movement to facilitate the development of brain stimulation (Luke, Vail, & Ayres, 2014). Schaaf,

Schoen, May-Benson, Parham, Lane, Smith-Roley, and Mailloux (2015) found the use of dynamic seating to decrease disruptive movement in the classroom, as well as decrease off-task behaviors that were verbal, passive, and/or motor when compared to baseline data of the same students. The typical standard chair in a classroom is static and does not engage the inner-core. A dynamic air-filled cushion added to the static chair allows the student to engage their inner-core and facilitates the movement necessary to build brain function (Schaaf et al., 2015).

### **Documentation**

Research conducted for this paper included using the online library through Northcentral University and the researcher's local university. Databases within the online library produced peer review journal articles and reports from the past five years. Literature were obtained from EBSCOhost, ERIC, IEEE Xplore, ProQuest, Sage Journals, ScienceDirect, and SpringerLink databases. The key words used in the main university search engine were (a) proprioceptive input, (b) classroom management, (c) fidgets in the classroom, (d) elementary strategies, (e) air-filled disc/disk, (f) types of learners, (g) brain activity/breaks, (h) classroom study, (i) effective teaching, (j) fine motor movement, (k) learning needs of students, (l) movement, and (m) sensory integration. Utilizing the local university library was helpful for articles that could not be found online. Personal educational journals were also utilized from the last five years. From the literature search, the following topics were determined more relevant to the topic being studied and will be discussed in detail: 1) proprioception; 2) classroom management; and 3) multi-tiered system of support.

## **Proprioception**

Movement is imperative to overall health (Fede, 2012). Proprioceptive movement is defined as kinesthetic activities which engage the inner-core (Luke et al., 2014). These movements reinforce cognitive skills and optimal learning in the classroom (Fede, 2012). Exercise is a form of proprioceptive movement and has many benefits for the body (Patten, Sickmann, Hryciw, Kucharsky, Parton, Kernick, & Christie, 2013). Of interest to this study, are the functional benefits of engaging the inner-core for the brain as this relates to classroom learning. The elementary students used in this study are sedentary for the largest portion of their school day with only 35 minutes out of 440 minutes devoted to recess activities daily. The U.S. Department of Health and Human Services recommends children six to 17 years of age should participate in at least 60 minutes of physical activity each day (CDC, 2015). This would equate to 300 minutes per school week of necessary physical activity. The students used in this study are sedentary 1,965 minutes per week with only 235 minutes of prescribed physical activity which consists of 35 minutes of daily recess and twice weekly physical education classes for 30 minutes each, which is only 78% of the movement recommended by the U.S. Department of Health and Human Services. A sedentary routine is a factor contributing to poor educational performance in the classroom (Perera, Frei, Frei, & Bobe, 2015).

Gaps in physical activity provided by schools have led researchers to find solutions to provide movement which will improve student performance within the confines of the prescribed schedule (Hartano, Krafft, Iosif, & Schweitzer, 2015). Proprioceptive movement is known as productive movement (Becker, 2013). This proprioceptive movement engages the inner-core and allows students to enhance their

implicit learning of complicated materials (Fede, 2012). Exercise benefits the brain by increasing synaptic plasticity (Patten, Sickman, Hryciw, Kucharsky, Parton, Kernick & Christie, 2013). When children are seated on an air-filled disk it provides an unstable surface, causing the body to move to correct balance (Fede, 2012). These movements improve their inner core and provide postural support (Patten et al., 2013). These movements mimic those found in outdoor activities (Smedegaard, 2016).

Decreases in recess activities are contributing to students being asked to sit still for longer periods of time and this is affecting their ability to acquire information (Horner et al., 2014). Proprioceptive movement is purposeful movement that allows students to gather information about where their body is in time and space (Kilbourne, 2011). When children participate in proprioceptive movements, they arouse pressure receptors in their muscles, tendons, and joints providing information which helps them integrate where their body is in time and space (Clemes et al., 2015). This provides necessary connections within their brain, increases their visual memory, helps them sleep better, and aids their reading abilities (Kilbourne, 2011). Kilbourne (2011) emphasizes the need for bilateral integration as this connects both hemispheres of the brain. A student's ability to read sight words and use phonics is tied to their ability to bounce cross-laterally without forethought. Actions on the left side of the body are processed in the right hemisphere of the brain which is the creative processing side of the brain (Kilbourne, 2011). Actions on the right side of the body are processed in the left hemisphere of the brain which is the language processing side of the brain (Kilbourne, 2011). Fidgeting increases, the ability to retain information (Rotz & Wright, 2013). One might witness adults in a professional

development audience bouncing a foot, fidgeting with a writing utensil, twirling their hair, or doodling. This is an adult version of socially appropriate fidgeting.

A multiple baseline design evaluated the effects of jogging on on-task behavior (Nicholson et al., 2011). Participants jogged for 12 minutes, followed by a five-minute cool down walk. This research study found the participants had increased percentages of on-task behavior through this proactive approach to off-task behavior (Luke et al., 2014). Using a momentary time sample at 15 second intervals in a 60-interval day, the researchers found Student A's on-task behavior improved from 58.6% to 78.6%. Student B's on-task behavior improved from 64.2% to 81.4%. Student C's on-task behavior improved from 58.4% to 71.6%. The students were three, four, and five years old with special needs. The researcher's findings indicated a positive correlation between physical activity and cognitive improvement (Luke et al., 2014).

Further research studies have found physical activity has a positive impact on cognitive abilities (Block, Taliaferro, & Moran, 2013; Fedewa et al., 2015; Forsey, 2014). Children do not readily engage in physical activity without teacher support (Luke et al., 2014). Teacher facilitation of physical activity is imperative to engage the proprioceptive input to gain on-task engagement (Luke et al., 2014). Exercise enhances the potential for improved cognition by increasing the synaptic plasticity of the brain (Ratey & Loehr, 2011). While sitting on an air-filled disk is not the equivalent of jogging, it does keep the body working to balance and thus engages the inner-core muscles (Fede, 2012).

The Stroop Test (Stroop, 1935) is a common measure of attention and executive function (Ratey & Loehr, 2011). The Stroop Test consists of three undertakings (a) reading words, (b) naming the color of ink, and (c) naming a color word written in an

alternate color (Ratey & Loehr, 2011). Typically, respondents are quick to complete the first two subsets of this test; however, the third task requires higher executive function skills and many struggle with this sub-test (Jimenez & Mendez, 2013). Ratey and Loehr (2011) found subjects who engaged in physical activity had improved functions in the third sub-test after a single session of physical or resistance exercise.

**Proprioceptive input and brain function.** Productive movement in the classroom is defined as kinesthetic activities which reinforce cognitive skills and optimal learning (Fede, 2012). This productive movement helps students absorb new cognitive skills, as well as, differentiate and generalize this information by increasing their retention of the material (Becker, 2013). The National Association of Sport and Physical Education sent out a position statement encouraging schools to understand the critical need for movement in educating the whole child (NASPE, 2011). NASPE (2011) felt movement aided the students' organization of their thoughts. When teachers give feedback in the classroom, students need an opportunity to process, comprehend, and generalize this information into their working memory (Brookhart, 2012). Movement helps students enhance their implicit learning of complicated materials (Fede, 2012). When students receive new information, it is not just processed in the brain; the whole body processes the information through productive movement and other brain integration systems (Reilly et al., 2012). Babies begin their life by exploring through movement. If one watches the progression of an infant through their toddler years, the child is in constant motion. This exploration of movement continues for five years and then comes to a halt when they enter school and are told to sit down for long periods and be quiet (Fede, 2012).

The current seating provided in most schools in the United States is a hard-plastic chair with metal legs and a metal support holding up the backrest. This chair is called a static chair because there is no resistance movement between the chair and the student's posterior. When an air-filled disk is added to the static chair, the student must engage inner-core muscles to remain balanced in the chair. This provides proprioceptive movement and helps the student connect their body awareness to time and space. When the body is connected to the environment in this way, neuroplasticity can occur and the synapses fire in the frontal lobe. This helps the student connect the information coming in from the classroom for later retrieval.

**Proprioceptive input and physical health.** Benes, Finn, Sullivan, and Yan (2016) studied teacher perceptions on purposeful movement in the classroom. The educators surveyed knew little about purposeful movement in the classroom; however, they indicated a desire to learn more (Benes et al., 2016). Pre-service education to teachers focuses on the need to share the objectives of the learning with students as they are taught (Brookhart, 2012). Specifically, this sharing of objectives focuses on the core academics and the objective for each subject. Keeping this in mind, the researchers felt it would be important for students to understand why the addition of movement into the classroom was being introduced (Benes et al., 2016). As respondents to the survey stipulated, they were most worried about how their students would feel about adding movement into their learning (Benes et al., 2016). After implementing movement activities, the respondents discovered the students were more actively engaged and found the pursuits fun as well as beneficial in aiding the students' integration of the new learning into their current knowledge base (Benes et al., 2016). Providing air-filled disks

to the static chairs adds movement to the student's day. Helping students understand the importance of using the air-filled disk as a tool would be vital to the success.

The American Association of Pediatrics reports recess promotes social and emotional well-being through reciprocal play and movement exercises (Murray & Ramstetter, 2013). A recent study conducted in Fort Worth Texas found tripling recess equated to higher performance in the classroom (Rhea, 2016). After studying the success of Finland's school system, Rhea implemented a similar model at the Eagle Mountain Elementary School, resulting in fewer discipline issues and better problem solving skills for all the students (Rhea, 2016). The students were more focused and less fidgety (Rhea, 2016). This is in line with the findings of the American Academy of Pediatrics which reports after recess students are more observant and better able to respond to cognitive skills (Murray & Ramstetter, 2013).

Researchers Carlson, Rowe, and Curby (2013) found that movement can engage large muscles of the body or fine motor actions which engage only one or two muscle groups. Dancing, running, and marching would be large motor movements; while writing, tapping a pencil to a beat, or picking up small objects would be fine motor movements (Becker, 2013). Large and fine motor skills can be assets to helping students engage their brain into learning new avenues (Carlson et al., 2013). Classrooms that integrate movement into academic tasks find students retain the information and are able to recall that information at a later time (Beckham, 2013). The addition of air-filled disks provided movement for the student and helped them focus on the task at hand.

The typical classroom is equipped with a hard-static chair and metal and laminate desk that fits some but not all students appropriately. In the elementary school, the desk is

adjustable to a small extent; however, some students find the angle uncomfortable and begin to move to find comfort (Smith-Roley et al., 2015). The lack of response to movement from a hard-static object can cause discomfort and take a student's mind off the task at hand (Beckham, 2013). Decreases in outdoor play for students both at school and home have led to more sedentary time in a static chair (Perera et al., 2015).

Considering the lack of movement provided by a static chair and knowing physical activity improves the academic achievement of students as well as their overall health, it behooves the school to explore alternative seating choices (Juonola, Viikari, & Raitakari, 2013).

It is also important to note the human anatomy when considering seating arrangements for students. The pelvic floor of a female is an arched curve distributing the weight equally across both hips. The pelvic floor of a male is an inverted V localizing the weight in a central location (Gray, 2013). Furthermore, the tailbone of a female is higher upon birth than a male. The female has a pocket of fat between the tailbone and the hard surface of the chair. The male tailbone is only protected by a thin layer of dermis (Gray, 2013). While the appropriate seated position is not directly upon the tailbone, observations of students show they frequently sit in a rounded position; which pushes the tailbone into the chair. Finally, the center of gravity for a female is in the hip area (Gray, 2013). The center of gravity for a male child is in the chest (Gray, 2013). Males are less likely than females to find comfort in being seated on a static chair.

***Fidgeting.*** Another type of purposeful movement in the classroom is called fidgeting (Katch & Katch, 2013). Purposeful fidgeting was first studied at the Mayo Clinic in 1998 (Katch & Katch, 2013). In more recent studies, researchers have found

allowing students to fidget at their desks increased on-task behavior and decreased disruptions in children with ADHD (Hartano et al., 2015). For students with certain disorders like impulse control issues, sensory needs, or inattentiveness issues a study showed that with fidgets, that movement increased retention of material learned by 39% (Rotz & Wright, 2013). Researchers have discovered children have a need for movement in order to focus on complicated tasks, thus allowing them to store and process information (Keay-Bright & Howarth, 2012). Dr. Mark Rapport, professor of psychology at the University of Central Florida in Orlando found students are often restless when reading or performing math tasks, but can sit perfectly still when watching a movie. Parents and teachers have commented on this phenomenon of being able to sit in an engaged manner when watching a movie and not being able to sit still at the dinner table or through classroom tasks. The research findings showed restlessness was prevalent when students were required to store and process the information and restlessness was not present when they just had to hold the information (Keay-Bright & Howarth, 2012).

**Proprioceptive input and on-task behavior.** Preliminary research (Pfeiffer et al., 2008) conducted with second graders found significant statistical differences in attention to task (Pfeiffer et al., 2014). Fedewa and Erwin (2011) found that stability balls were used to determine the effectiveness of time on task and in-seat behavior. This research demonstrated a statistical significance and teacher preference for the strategy (Fedewa & Erwin, 2011). Providing proprioceptive and vestibular input through dynamic seating decreases off task behavior and improves attention to task (Schwabova et al., 2015). Children need to move in socially appropriate ways that allow them to organize their thoughts (Kilbourne, 2011). When seated in traditional static chairs, children

reposition themselves, sit on one foot, sway side-to-side, swing their legs, and tilt their chair back because they need to move (Smith-Roley et al., 2015). Children who are offered dynamic seating have improved (a) posture, (b) appropriate active engagement and decreases in (a) sensory seeking behaviors, (b) out of seat behavior, and (c) off-task verbal, passive, and physical behavior (Smith-Roley et al., 2015). More research is needed to substantiate the ability of dynamic seating to increase academic achievement and decrease classroom disruptions. There is a lack of extensive research on the positive results of dynamic seating.

Seifert and Metz (2017) found positive results with air-filled disks on student engagement at the preschool level in their current research study. They looked at 25 preschoolers divided between four preschool classrooms. Two classrooms were assigned as control and two were assigned as experimental. There were 15 students in the experimental group and ten in the control group. Their research found statistically significant improvements in maintaining student attention to activities.

*Using dynamic seating.* Schaaf, Schoen, May-Benson, Parham, Lane, Smith-Roley, and Mailloux (2015) found the use of dynamic seating to decrease movement in the classroom, as well as decreased off-task behaviors that were verbal, passive, and motor when compared to baseline data of the same students. Teachers were pleased with the results of adding dynamic seating and the redesign of the classroom. Schaaf et al. (2015) found children were more actively engaged within the classroom. Children reported feeling calmer in the classroom after the dynamic seating was added.

Schaaf et al. (2015) found student engaged time increased and overt behaviors decreased in the classroom. This experiment not only changed the seating choices in the

classroom, but added carpeting to decrease noise and organizational shelving to decrease visual distractions in the classroom (Schaaf et al., 2015). These results were achieved through dynamic seating and environmental redesign of the classroom to minimize audio and visual distractions. This research was conducted with neuro-typical peers at the second-grade level. The results were favorable for the students and the educators involved.

Many research studies have studied the effect of dynamic seating on students with autism, as students on the spectrum have been shown to have high levels of perceived inattention (Umeda & Deitz, 2011). Using a single-subject A-B-A-B-C interrupted time series design (Manolov, Gast, Perdices, & Evans, 2014), two kindergarten students diagnosed with ASD were given static chairs and then dynamic cushions added to the static chairs, which were lowered by two inches to accommodate for the two-inch thick air-filled cushion (Umeda & Deitz, 2011). This very limited research found the air-filled disks did not provide the sensory input necessary for children on the spectrum to increase in-seat behavior and decrease off-task behavior (Umeda & Deitz, 2011). Given this was very limited research, the results are not significant.

Previous research from 2008 did find the cushions effective for neurotypical students (Pfeiffer, Henry, Miller, & Witherell, 2008). This study is included in this literature review because it is seminal research and included 61 participants across six elementary schools (Pfeiffer et. al, 2008). Using a one-way ANOVA calculation comparing the effectiveness of the cushions between the control group and the treatment group, the analysis found a statistically significant difference between baseline and intervention (Pfeiffer et. al, 2008). The results identified an increase to task and less

classroom disruptions (Pfeiffer et. al, 2008). Many unpublished theses have replicated this research; however, none have performed specific research since the seminal article. This research proposes to complete that task.

*Using therapy/stability balls with students.* Therapy Balls, sometimes referred to as Stability Balls have had replicated research studying the effectiveness of student performance academically and behaviorally. Sensory processing is a known predecessor to successful learning (Burgoyne & Ketcham, 2015). In a North Carolina, general education second grade classroom, baseline data found only 50% of the students on task when seated in static chairs. However, when seated on dynamic seating such as Therapy Balls, 85% of the students were on task (Burgoyne & Ketcham, 2015). Another research study looked at success with one student with autism and found on-task behavior increased significantly with the use of therapy balls along with increased sensory integration (Schaaf et al., 2012). The research of Schaaf et al., (2012) was conducted on a student with autism; however, current statistics show as many as 5-10% of the neuro-typical student population have positive results with dynamic seating (Schult, Awosika, Schmunk, Hodgson, Heymach, & Parker, 2013). The research on children with autism was replicated in a 2014 study of 17 children with similar results (Schaaf, Benevides, Mailloux, Faller, Hunt, van Hooydonk, Freeman, Leiby, Sendeki, & Kelly, 2014). The 17 students in the experimental group scored significantly higher on goal attainment scores than the 15 students in the control group who did not receive sensory integration therapy (Schaaf et al., 2014).

Fedewa and Erwin (2011) conducted classroom observations of fourth and fifth grade classrooms in a rural southeastern state, found eight students who were considered

to have the characteristics of a child with ADHD. While five were diagnosed, three were not but had behavioral issues symptomatic of a child with ADHD. None of the students were medicated. Baseline data indicated the students stayed in their seats 45% of the time and were on task 10% of the time (Fedewa & Erwin, 2011). After the introduction of the Stability Balls, the students were in their seat 94% of the time and on task 80% of the time (Fedewa & Erwin, 2011).

When teachers were interviewed on their impressions of the Stability Ball, one teacher noted decreased noise levels (Fedewa & Erwin, 2011). A second teacher found moving and inappropriate fidgeting decreased in the classroom (Fedewa & Erwin, 2011). The one disadvantage mentioned by most of the teachers was the expense of the Stability Balls (Fedewa & Erwin, 2011). Given that school resource budgets are constantly strained; the cost factor must be considered. Research on the effectiveness of dynamic seating on academic and behavioral issues has the potential to change the learning environment for a vast number of students.

**Proprioceptive input and special education.** In a typical classroom, there are students with differing needs and abilities. For all students, there will be days where universal support at the academic and behavioral levels will work (Horner & Sugai, 2015). Other days, small groups of these students will need targeted support and a very small minority will need intensive support (Horner & Sugai, 2015). Meeting the needs of all students based on their abilities will decrease the amount of disruptions in learning and class time (Lord-Nelson, 2014). Many of the interventions which will assist the differing abilities in the classroom will involve some revision of the current environment (Fede, 2012). Some of the children who will need the most modifications and

accommodations are children with attention issues, learning issues, and social emotional behavior issues. Proprioceptive input can have a major impact on these students as well. Research indicates the students who will benefit the most from proprioceptive input are students with Attention Deficit Hyperactivity Disorder, Specific Learning Disabilities, and Sensory Processing Disorder.

*Attention deficit hyperactivity disorder (ADHD).* There are currently 5.5 million children aged four through 17 diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) in the United States (Wegrzyn, Herrington, Martin, & Randolph, 2013). This accounts for nine percent of the school-age children with 12.3% of boys and 5.5% of girls (LaMarca, 2014). An average classroom would have approximately two to three students who either are identified with ADHD or are symptomatic of the behaviors associated with ADHD. Of the 5.5 million children who are diagnosed with ADHD, approximately 66% are medicated with stimulant drugs (Wegrzyn et al., 2013). The stimulants in ADHD medication activate the neurotransmitters to fuel the prefrontal cortex and increase the dopamine levels in the brain (Trampush, Jacobs, Hurd, Newcorn, & Halperin, 2014; Wegrzyn et al., 2013). Dopamine is a neurotransmitter which is associated with movement and attention and can also be increased with exercise (Wegrzyn et al., 2013).

Many teachers believe stimulant drugs are the answer for all students with suspected ADHD; however, they do not understand the function of the medication and what it will and will not do for a student who has ADHD (Pindiprolu, 2014). It is the role of the educational system to provide successful school-based approaches in the way of proactive interventions for students with ADHD (Froelich, Breuer, Doepfner, & Amonn, 2012). The effectiveness of these approaches is dependent upon the interventions

developed by the teacher (Froelich et al., 2012). Many teachers rely on a daily behavior rating sheet paired with positive consequences to ameliorate disruptive behaviors in children with ADHD symptoms (Froelich et al., 2012). Another common intervention is the use of contingency reinforcement, known as a token economy (Froelich et al., 2012). Other interventions tried with less frequency by classroom teachers include response cost and time-out. Promising research has focused on peer tutoring and self-management strategies (Froelich et al., 2012). Perhaps professional development on the brain function of students with ADHD and the physical needs would decrease the notion that medication and punishment will ameliorate all behavioral issues (Pindiprolu, 2014).

A public elementary school in Cologne with 372 students engaged in a study on ADHD interventions (Froelich et al., 2012). Of the 372 students, only 320 were part of the study due to missing data from the other 52 students. The school consisted of 16 general education teachers and none of the teachers had previously been trained in behavioral interventions. The students were aged seven to 11 with 52% of them being of German heritage, 21% being Turkish heritage, 20% being Italian, and 7% accounting for all other nationalities (Froelich et al., 2012). Fifty-two percent of the students were male.

All 372 students were screened for ADHD and Oppositional Defiant Disorder (ODD) related symptoms in the classroom setting (Froelich et al., 2012). Utilizing the short German form of the Yale Children's Inventory, three to four students in each class who scored the highest were selected to participate in the intervention and control groups for this study (Froelich et al., 2012). Each teacher was assigned as either a control or experimental group for the intervention. Eight teachers had 25 of the students in the intervention group and eight teachers of 17 students had the control group (Froelich et al.,

2012). The eight teachers in the experimental group received 12 weekly lessons which were one-hundred-twenty minutes in length each on the etiology, symptoms, assessment and treatment of strategies of children with ADHD and ODD (Froelich et al., 2012).

Froelich et al. (2012) trained the teachers to use nine management strategies (a) make lessons stimulating for the students, (b) involve the students in the lesson, (c) reduction of complex information to the most important message, (d) give regular and immediate behavior specific praise, (e) develop and stay consistent on routines, (f) proactive transitioning skills which included movement, (g) find the least distracting spot in the room for the students, (h) provide organizational skills, and (i) be consistent in expectations and consequences. Froelich et al. (2012) found that in baseline, behaviors were found to be four percent of a low nature, 48% were of moderate problems and 48% were severe problems. After the intervention, Froelich et al. (2012) found the problem behaviors were listed at 64% low level problems and 36% moderate level problems. There were zero problems after the intervention that were in the severe problem category (Froelich et al., 2012).

The experimental teachers in the Froelich et al. (2012), reported not knowing they could use the principles of behavioral modification to specifically target inappropriate behaviors in the classroom and had no precise classroom strategies for dealing with ADHD students. The teachers reported enjoying and gaining the knowledge from the training provided by a child psychologist on ADHD and ODD, along with the ability to collaborate with the other experimental teachers on the strategies. Teachers also reported the interventions provided by the child psychologist were suitable for all the students in their class. The teachers felt the knowledge gained was easier to digest and utilize than a

cumbersome token economy system (Froelich et al., 2012). Finally, the teachers felt the information gained helped them work with the students' parents in the completion of homework (Froelich et al., 2012).

Moore et al. (2016) found that many educators believe preferential seating is an intervention for students with ADHD. Preferential seating is typically viewed by classroom teachers as being seated at the front of the classroom. Moore et al. (2016) state many students with ADHD perceive preferential seating as a punishment with varying results (Moore et al., 2016). Researchers Farley, Risko, and Kingstone (2013) have found children with ADHD need proprioceptive input to help them organize their thoughts. This can be addressed through the addition of dynamic seating rather than preferential seating.

Burgoyne and Ketcham (2015) found significant differences in student behavior between being seated on static seating and dynamic seating. In the static chairs the students rocked, bounced or had other behavior (Burgoyne & Ketcham, 2015). In the dynamic seating, students rocked, bounced, kneeled, engaged in what is known as W-sitting, or shook (Burgoyne & Ketcham, 2015). Burgoyne and Ketcham (2015) state that W-sitting is when the student is seated on the chair or floor and rotates their knees inward with the feet placed behind forming a W with the legs. The researchers also measured the intensity of on and off task behavior between the two types of seating. Burgoyne and Ketcham (2015) found the use of therapy balls versus the static chairs afforded the students more opportunities for sensory stimulation which resulted in higher frequencies of on-task behavior (Burgoyne & Ketcham, 2015).

Wan-Yunus, Liu, Bissett, and Penkala (2015) found the most promising research on non-medicated interventions for dealing with behavioral issues looked at three main

areas: tactile, proprioceptive, and vestibular sensory integration. The highest positive results were tactile interventions (Wan-Yunus et al., 2015). The dynamic seating considered for this research is an air-filled disk with a tactile surface on the top side of the cushion. Wans-Yunus et al. (2015) stated the variability of the air within the dynamic seating will allow the students to move in their seat and provide proprioceptive input. This intervention will fulfill two of the three promising non-medicated interventions by providing proprioceptive input and tactile input for the students.

Dynamic seating means the air-filled disk the ADHD students are seated upon will move as they wiggle (Wans-Yunus et al., 2015). Wans-Yunus et al. (2015) found that the ability to wiggle within one's own seat is proprioceptive input through tactile contact with dynamic seating. Cardini, Haggard, and Ladavas (2013) state proprioception has been defined as knowing where one's body is in time and space and being able to maneuver through the environment. Moore et al. (2015) found that children with ADHD have less of a concept of where their body is in space and time.

Moore et al. (2016) found that many children with ADHD find it difficult to concentrate when they are engaged in activities where they are not active; however, they can spend hours engrossed in an action filled video or video game. Efrat (2016) stated that all children are moving less frequently due to the popularity of indoor video games and decreases in recess time or outdoor play. Children with ADHD are more likely to lose recess privileges due to out of seat behavior, yet they need recess to be able to concentrate and succeed in the classroom (Reeves, Miller, & Chavez, 2016). While sitting on an air-filled disk will not replicate all of the activities a student may engage in

during a recess period, it will engage the inner-core in resistance training and this has the potential to increase dopamine within the ADHD brain (Wegryzyn et al.,2013).

***Specific learning disabilities.*** Specific learning disabilities is a term used to represent a group of disorders. It is a neurological disorder that affects how a student learns. Forty-one percent of all students in special education are identified as learning disabled (NCES, 2014). The most common disorders discussed in school are dyslexia, dyscalculia, dysgraphia, and dysphasia. Dyslexia is considered a reading disability. Dyscalculia is considered a mathematical disability. Dysgraphia is considered a writing disability. Finally, dysphasia is considered a language disability. Each of these can cause learning problems in any subject. Trampush et al. (2014) found that while educators have many instructional strategies through multi-tiered intervention systems of support (MTSS), accommodations, and modifications; very little has been provided to educators in the way of behavioral techniques which arise due to the learning issues. The DSM-V now categorizes specific learning disabilities (SLD) as a broad term covering difficulties in reading, calculating, and writing (American Psychiatric Association, 2012).

***Dyslexia.*** Dyslexia is considered a SLD in which students with normal to high intelligence suffer from the inability to recognize words when reading and spelling (Kaltner & Jansen, 2014). The National Center for Learning Disabilities (NCLD) reports that some students see halos around letters, rivers of white space between words and letters, blurry edges, and in some cases the letters seem to jump around on the page (2016). This jumping around of letters was originally called Scotopic Sensitivity Syndrome (SSS) (NCLD, 2016). It is now more commonly referred to as visual stress

when reading. It can cause stomach aches, nausea, headaches, and other maladies many teachers assume is trying to escape work (Kercood & Banda, 2012).

A research study by Goodmon et al. (2014) found that students with dyslexia had improved behavior, attention, and motivation when seated on dynamic seating. Goodmon et al. (2014) stated that the only improvement not seen with the introduction of dynamic seating was an improvement in reading comprehension, perhaps accounted by abnormal eye movement paired with poor motor coordination as the study used large stability balls. While the stability balls are a form of dynamic seating, perhaps the use of air-filled disks rather than balls would net different results. The air-filled disks provide resistance without the bounce provided by the stability balls. Since many students with SLD have poor motor control, stabilizing a ball with one's feet on the floor as well as coordinating movement to contain balance may be too much.

Goodmon et al. (2014) used 24 fifth grade students from a school specifically for children with dyslexia from two classrooms. All 24 had been formally diagnosed with dyslexia or dyslexia and ADHD (Goodmon et al., 2014). The co-existence of ADHD with dyslexia was 42% in one classroom and 50% in the other (Goodmon et al., 2014). In this study, the male to female ratio was 79% male to 21% female with the median age range ten years of age (Goodmon et al., 2014). The control and experimental class had similar schedules and demographic characteristics (Goodmon et al., 2014).

Goodmon et al. (2014) used stability balls which were sized so that each child could comfortably sit with their hips and knees at a 90-degree angle with their feet on the floor. All of the students were taught by a physical therapy instructor how to properly sit on the stability balls (Goodmon et al., 2014). The experimental phase of the research was

the introduction of the therapy ball to each group to determine generalization and residual effects (Goodmon et al., 2014). The researchers used a pretest-posttest control group with switching replication in a time series (Goodmon et al., 2014).

The teachers and experimenters developed a list of 14 undesired behaviors considered to distract from learning (a) looking away from the teacher when inappropriate (b) looking away from materials when inappropriate, (c) responding inappropriately, (d) not sitting in WOW position, (e) failing to raise hand when responding, (f) silent during choral activities, (g) getting out of seat when inappropriate, (h) not participating in conversations on topic, (i) fidgeting, (j) talking off topic to classmate, (k) putting hands on classmate, (l) failing to complete assignments on time, (m) complaining about work, and (n) displaying negative attitude towards learning (Goodmon et al., 2014). Five research assistants from Florida Southern College served as inter-observer reliability guides by sitting in the classrooms using naturalistic observations and a frequency measure for a total of 15 observations per class (Goodmon et al., 2014). The inter-rater reliability was .79 and .74, indicating a high consistency with observations between classrooms (Goodmon et al., 2014).

Using a chi-square analysis, the students significantly wanted to continue the use of stability balls with  $p=.004$  (Goodmon et al., 2014). The following positive behaviors had significant increases with the use of the stability balls (a) talking on topic to classmates, (b) keeping hands to self, (c) speaking positively, and (d) asking related questions (Goodmon et al., 2014). The control class showed increases in the inappropriate behaviors of fidgeting and displaying negative attitude (Goodmon et al., 2014). Finally, Goodmon et al. (2014) used a Likert scale where 1 equaled least

enjoyable/focused-attentive to 5 equaled most enjoyable/focused-attentive, the students reported an enjoyment level of 3.96 (SD= 1.12) for enjoyment and an attentive level of 3.88 (SD= 1.30). This research study of Goodmon et al. (2014) supported the use of dynamic seating with students with dyslexia. Higher results may be achieved with the air-filled disks over the stability balls.

***Dyscalculia.*** Dyscalculia is the inability to perform math computation and have difficulty with math reasoning despite having the intelligence and capability of their peers (Raja & Kumar, 2012). Educators are trained in MTSS strategies, accommodations and modifications for children who struggle with math concepts; however, there are many types of dyscalculia that are not addressed in the general education preservice training (a) verbal dyscalculia, (b) praxiognostic dyscalculia, (c) lexical dyscalculia, (d) graphical dyscalculia, (e) ideognostic dyscalculia, (f) operational dyscalculia, and (g) sequential dyscalculia (Raja & Kumar, 2012). Each of these sub-types of dyscalculia have different struggles for the students from difficulty naming the operations in math to counting numbers in sequence (Kucian, & von Aster, 2015). Dyscalculia is as common as dyslexia and yet not as widely discussed (Vukovic & Lesaux, 2012).

Vukovic and Lesaux (2012) contend researchers have often overlooked the significant language demands of mathematics besides the obvious example of word problems. Sowinski et al. (2012) found mathematical difficulties might be a deficient linguistic process as opposed to deficits in processing quantitatively. Studies suggest the coexistence of dyslexia and dyscalculia is as high as 20-60% of students (Raja & Kumar, 2012). Raja and Kumar (2012) state that it is perceived that the difficulty lies in retrieving conceptual knowledge from long-term memory. If this is true, the hypothesis that

proprioceptive input helps students organize their thoughts in their brain could prove as effective for dyscalculia as dyslexia and ADHD.

***Dysgraphia.*** Dysgraphia is a difficulty with handwriting and can interfere with a student's spelling, handwriting, ability to put thought to paper and express ideas (NCLD, 2016). There are several subtypes of dysgraphia including dyslexic dysgraphia, motor dysgraphia and spatial dysgraphia (Casey, 2012). Casey (2012) state children with dyslexic dysgraphia typically have illegible handwriting when done extemporaneously and their oral spelling abilities are inferior; however, if they are copying written text, the student can write legibly. On the contrary, children with motor dysgraphia have illegible handwriting whether it is written extemporaneously or copying from a sample, but their oral spelling is normal (Casey, 2012). Finally, students with spatial dysgraphia have illegible handwriting whether spontaneous or copying, are excellent spellers but they are unable to draw very well (Casey, 2012). Some experts believe there is a dysfunction in phoneme to grapheme transcribing for students with dysgraphia (NCLD, 2016).

Researchers Khaledi, Validi-Pak, Mirkhan, and Atai (2014) found that play therapy has shown a reduction in spelling errors for children with the specific learning disability of dysgraphia. Barzegary and Zamini (2012) state play therapy has also shown an increase in short term memory in transcribing phonemic to graphemic abilities for students who struggle with dysgraphia. The play therapy involved sensory integration interventions which may have regulated sensory input to help the students organize their thoughts (Khaledi et al., 2014). The overall finding of the study conducted by Khaledi et al. (2014) found improved visual memory, auditory memory, and attention span for students with dysgraphia when presented with sensory integration therapy.

***Dysphasia/Aphasia.*** In the United States, most practitioners refer to this disorder as aphasia instead of dysphasia, which is the European term for this specific learning disability (NCLD, 2016). No research studies were found within the last five years on aphasia other than for stroke patients. Aphasia is considered a specific learning disability that is a communication disorder and is the result of damage to the left side of the brain (Pentland et al., 2016). Students with aphasia have normal intelligence but have difficulty speaking or listening which may also interfere with reading and writing (Pentland et al., 2016). There are no students with aphasia in the research study.

***Other conditions.*** There are other conditions which can be classified as a learning disability. Swanson, Lee, Harris, and Graham (2014) state that sometimes certain learning disabilities are called language processing disorder or auditory processing disorders. Dyspraxia of speech is another rare condition typically associated with children with autism. Children with dyspraxia can also be affected with poor coordination and exhibit extreme aversion to tactile issues (Swanson et al., 2014). Swanson et al. (2014) state the list continues with difficulty with memory and executive function skills; however, most common in schools is to hear learning disabilities paired with a reading disability, math disability, or a writing disability. Proprioceptive input appears to be a potential treatment for many SLD executive function issues.

***Sensory Processing Disorder.*** Sensory Processing Disorder (SPD) was first described by Jean Ayres in the 1970's (American Academy of Pediatrics [AAP], 2012). This disorder describes the child's ability to process the sensory environment (Zimmer & Desch, 2012). Luke et al. (2014) described sensory input as the ability to take in information from visual, auditory, proprioceptive, or vestibular input and organize these

into a sensory system in the brain; which leads to deficits in academic and social regulation. Most schools provide sensory integration therapy through the use of occupational therapists; however, these therapies are limited (Zimmer & Desch, 2012).

Sensory integration is the manner in which the nervous system organizes and integrates the information coming in from the environment (Schaaf et al., 2013). Schaaf et al. (2013) found children who have sensory processing disorder (SPD) respond to the sensory stimuli in non-adaptive and non-appropriate ways. Van Hulle, Lemery-Chalfant, and Goldsmith (2015) state children who have SPD have difficulties in the areas of self-care, social interactions, reciprocal play, and academic success. Many children with SPD have decreased academic performance, shorter attention spans and have a greater chance for learning disabilities in the classroom (Van Hulle et al., 2015). One in six students may have sensory processing disorder of some degree (Schoen, Miller, & Hampton, 2014). This would account for at least three children in a classroom of 22 students. It is possible one of the students with LD or ADHD could have a comorbid condition of SPD with their primary disability category.

Children with SPD are many times diagnosed incorrectly (Brandwein, Foxe, Butler, Frey, Bates, Shulman & Molholm, 2015). The symptoms apparent at school are (a) being in motion constantly and then coming to a complete fatigued state, (b) averse to touch, (c) sensitive to food texture, (d) sensitive to odors, (e) hypersensitive to anything touching their skin (clothing, socks, tags), (f) aversion to putting hands in anything dirty, (g) averse to some movements, (h) inability to self-regulate after upset or strenuous exercise, (i) balance issues, (j) abnormal posture, (k) difficulty with pincer grasp, (l) averse to loud sounds, or (m) adherence to a lack of variety (Brandwein et al., 2015).

Zimmer and Desch (2012) found many students with SPD also have autism spectrum disorder (ASD). A single subject multiple treatment withdrawal design examined the use of stability balls and air-filled cushion seating for these students with SPD (Sadr, Haghgoo, Samadi, Rassafiani, & Bakhshi, 2015). Citing a large study of 200 children with autism (Wieder & Greenspan, 2003), Sadr et al. (2015) found a physiological need for sensory stimulation due to 95% of the students having difficulty with modulation of their sensory needs. Using a single subject multiple treatment withdrawal design, Sadr et al. (2015) explored the use of stability balls and air-filled cushions. During the first phase the students sat on static chairs, followed by a phase with air-filled cushions and the final phase was with stability balls (Sadr et al., 2015). Sadr et al. (2015) used a convenience sample of students reported to have difficulty with in-seat and on-task behavior. The students were between the ages of seven and ten years old and were not told the reason for the study (Sadr et al., 2015).

The researchers found the use of the air-filled cushion increased on-task behavior of almost all students with SID; however, the balls were difficult for the students who had balance problems and did not increase their on-task behavior (Sadr et al., 2015). The teachers interviewed felt the dynamic seating prevented disruptions in the classroom (Sadr et al., 2015). The first student increased in-seat behavior by 33% with the air cushion and in-seat behavior dropped 18% when the cushion was removed (Sadr et al., 2015). The second student increased in-seat behavior by 5% when seated on the air-filled cushion and dropped by 13% when the cushion was removed (Sadr et al., 2015). The third student increased in-seat behavior by 48% when seated on the air-filled disk and reduced 33% when the cushion was removed (Sadr et al., 2015). The final student in this

study increased in-seat behavior by 15% when the air-filled disk was added and decreased by 17% when the air-filled disk was removed (Sadr et al., 2015). This is an overall increase average of 25% in in-seat behavior among the four students.

Faramarzi, Rad, and Abedi (2016) found sensory integration used with elementary aged children can improve their executive functions. This was essentially found to be true for students who have an ADHD diagnosis, but was found for all aged elementary students. All students were given some sort of a sensory stimulant that helped each one to improve in an area that they were struggling with in the classroom. Faramarzi, Rad, and Abedi (2016) stated each student was found to have a different learning need and adjustments were made for each individual and not the same intervention for the whole class. This would be differentiated planning for individual differences for sensory integration.

Sensory-based therapies are slowly becoming known throughout school districts. Barton, Reichow, Schnitz, Smith, and Sherlock (2015) stated sensory-based therapies; also, known as sensory integration; have mainly been used within the special education department of schools. The research found when using sensory-based therapy on not only students with disabilities or learning behaviors, but also used for all students within a general classroom it created an organizational regulation (Barton et al., 2015). Barton et al. (2015) reported that additional research needs to be conducted in additional areas and with different populations to support this idea fully to show that sensory integration should be used in some way in all classrooms.

Walker (2016) stated that sensory integration is essential for students with proprioceptive needs as they will need sensory input several times throughout the day

depending on the specific needs of the child. For instance, riding the bus to school can be extremely overwhelming to the auditory senses and this will cause the child to engage in self-injurious behaviors. Walker (2016) gave an example that in order to calm the child down from the over indulgence on the sensory system, the occupational therapist may suggest the child come into the school after the bus ride and engage in a sensory activity called the burrito. The child lays on the floor on a soft mat and roll themselves inside the mat while a therapist rolls a small weighted ball on their back, much like a light massage for a period of five-minutes (Walker, 2016). Another child with proprioceptive needs may need to jump on a trampoline for five-minutes before they can sit down and do some seat work for 40 minutes (Walker, 2016). Yet another child may need to swing in an air-walker for ten minutes before the child can walk down a hallway (Walker, 2016).

Leong, Carter, and Stephenson (2015) found that some children have a mild aversion to touch, such as tags in clothing and seams in socks. Other children are so sensitive to their environment; they do not tolerate certain food because they can taste the soap used to clean the pan in which the food was cooked (Leong, Carter, & Stephenson, 2015). Leong et al. (2015) suggests that an occupational therapist deciphers the complexity and severity of the sensory overload each child is dealing with in sensory integration issues. Simple things like the pattern in wall-to-wall carpet can make children with sensory issues dizzy (Walker, 2016). Many children with sensory issues can hear the whirring of air conditioners ten times louder than neuro-typical children and this can cause them to be unable to cope with the environment (Leong et al., 2015). It is not as simple as just deciding to put a weighted vest on a child because they have sensory issues. Each child's sensory needs must be differentiated (Leong et al., 2015).

**Proprioceptive input and special education.** A meta-analysis of 25 studies found a lack of scientific evidence for sensory integration therapy (SIT) for students with autism spectrum disorders (ASD); yet, 82% of the occupational therapists interviewed (n=292) reported using SIT with students with ASD (Lang et al., 2012). While SIT is not an evidence based strategy for students with ASD, it has been found effective for students with attention difficulties in numerous studies (Wu, Wang, Chen, Lai, Yang, & Guo, 2012). Using electroencephalography (EEG) imaging, the researchers found students with ADHD had faster reaction times when seated on dynamic seating versus seated on static chairs (Wu et al., 2012). This means the students' information processing increased (Wu et al., 2012). When using dynamic seating the difference in processing time between ADHD students and non-ADHD students is insignificant; however, when seated on static chairs the reaction time was significant between the same two groups with ADHD students performing much slower (Wu et al., 2012). Sitting on the therapy ball appears to increase the attention span for students with ADHD and decreases the lag time denoted when seated in static chairs between neuro-typical students and students with ADHD (Wu et al., 2012).

Researchers Rotz and Wright (2013) state purposeful movement and fidgeting are recommended for many students with disabilities who are served in the general education classroom. The U.S. Department of Education National Center for Education Statistics (NCES) reports 61% of students served under the Individuals with Disabilities Education Act (IDEA), spend 80% or more of their day in the general education classroom (2012). The 2004 revision of IDEA compels schools to educate all students with disabilities in the least restrictive environment (LRE). This requires schools to provide services as

much as possible in the general education classroom (IDEA, 2014). Students can only be served in a more restrictive environment if the severity of their disability prohibits their ability to learn in the general education classroom; therefore, most students with learning disabilities (LD) and attention deficit hyperactive disorder (ADHD) would be served within the general education classroom at least 80% of the student's day (IDEA, 2014). General education teachers receive some training in their preservice courses on how to differentiate instruction for learners with LD and ADHD (Parker, Alvarez-McHatton, & Crisp, 2014). Researcher Callan (2013) found that most teachers surveyed would prefer more specific training on how to differentiate instruction for LD and ADHD students beyond the scope of that taught in preservice education. Perhaps training on non-medicated interventions using environmental changes would be beneficial to the field.

### **Classroom Management**

Research suggests providing proprioceptive input will increase on-task behavior in the classroom; however, the question of classroom management should be addressed (Sugai & Horner, 2012). It would be imprudent to suggest the mere action of adding air-filled disks to chairs would improve classroom performance. As with many theories in pedagogies, one cannot exist without the other. Sugai and Horner (2012) state Positive Behavioral Interventions and Supports (PBIS) is not solely capable of changing the school climate, one must also incorporate appropriate responses to the academic side of the pyramid by providing a research-based intervention for all three levels on the academic realm. Therefore, one must adhere to strong classroom management strategies before making the assumption the air-filled disks will provide any reinforcement for on-task behaviors (Sugai & Horner, 2012).

Researchers Marquez, Vincent, Marquez, Pennefather, Smolkowski, and Sprague (2016) found challenges with classroom management still exist for many teachers despite a plethora of professional development opportunities on the topic. While researchers Sugai and Horner (2012) state professional development on classroom management tends to be given in a “sit and get” model, rather than the needed modeling with exemplars. One model that is currently being implemented in 23,000 schools around the world is PBIS (Marquez et al., 2016). Schools that engage in Universal PBIS tend to attend a two-day training that focuses on the systemic changes required for implementation rather than specific strategies for classroom management (Reinke, Herman, & Stormont, 2013). The first year of PBIS implementation is totally focused on the universal or whole school level. A representative team of ten to 14 staff attend the two-day training and are expected to take the information back to the school to implement with fidelity (Sugai & Horner, 2012). Mitchell, Stormot, and Gage (2011) state the second year, the tier two team attends a one or two-day training on classroom management strategies. Again, this team is expected to take the systemic change process back and share with the staff to implement with fidelity (Mitchell, Stormot, & Gage, 2011).

Marquez et al. (2016) state professional development should be taught and then imprinted by modeling with specific examples. Teachers should then be allowed to practice within their own context and be given direct feedback from a supervisor on their implementation of the new skill. Therefore, the coaching model is an integral component of PBIS; however, many school districts try to implement in a short sit and get model and try to implement with no coaching support (Marquez et al., 2016). Marquez et al. (2016) found professional development model does little to enhance the effectiveness of the

teacher's skills within the classroom. Educators need to understand the functions behind the communication of behavior to apply interventions which will change the behavior (Marquez et al., 2016). A coach could provide these opportunities through monthly contact.

The research school has been implementing PBIS with fidelity at all three levels for ten years. All staff involved in the research have been part of the PBIS team and meet weekly to discuss academic and behavioral interventions. The district provides academic and behavior coaches who visit every week. All interventions at tier two and tier three are verified with data collection to ensure implementation fidelity of fit.

Effective classroom management is a vital component required for student success in academic achievement (Marquez et al., 2016). Utilizing an online training module Marquez et al. (2016), developed a Classroom Management in Action (CMA) module program. The CMA consisted of planning and organization, proactive prevention, and responding to target behaviors (Marquez et al., 2016). Educators were given a tool to help monitor the responsiveness of their students to the interventions they employed. This tool was called the Progress Monitoring Tool (PMT). Finally, the teachers were trained on data-based decisions using a response to intervention (RtI) logic model (Marquez et al., 2016).

The results of field testing the three components of the CMA modules found teachers need to receive professional development on classroom management in small doses with opportunities to be interactive and move at their own pace (Marquez et al., 2016). The National Council on Teacher Quality found preservice training in classroom management as minimal (2013). The preservice training tends to contain non-research

based interventions with minimal implementation opportunities contained within the preservice sessions (Greenberg, Putnam, & Walsh, 2014). The authors suggest using video based technology as a means of providing meaningful training on classroom management (Marquez et al., 2016).

**Elements of classroom management.** Jackson, Simoncini, and Davidson (2013) researched effective practices for preservice teachers and found approximately 12 hours are devoted to classroom management over a four-year teaching degree at James Cook University. The researchers found no stand-alone unit on classroom management offered at the university level. Many colleges focus four classes (three hours each) on classroom management (Jackson, Simoncini, & Davidson, 2013). The Queensland College of Teachers defines ten essential skills for classroom management as (a) establishing expectations for the classroom, (b) providing instructions, (c) wait time and scanning for understanding, (d) behavior specific praise to one student to cue others, (e) using body language to convey encouragement, (f) behavior specific praise to all, (g) ignoring some inappropriate behaviors, (h) redirecting, (i) offering choices, and (j) consistency (Jackson et al., 2013). The researchers conducted a program to determine if a mentoring teacher could enhance a new teacher's ability to incorporate the ten essential skills into their teaching routine. The research utilized video models of the essential skills for classroom management being modeled by veteran teachers along with opportunities to practice with mentoring teachers. Using pre-and-post survey responses, the preservice teachers felt better prepared to begin their own classroom with the introduction of the essential skills for classroom management taught, modeled, practiced, and praised by the mentoring

teachers (Jackson et al., 2013). Again, the coaching model proves to be most beneficial to increasing classroom management strategies.

Classroom management in the United States is rarely taught as a stand-alone course for pre-service teachers (Stough, Montague, Landmark, & Diehm, 2015). Beginning teachers who leave the profession cite lack of ability to manage behaviors as one of the main reasons for leaving (Stough & Montague, 2015). For over 50 years, teachers have reported classroom management and discipline as a major concern (Stough & Montague, 2015). Beginning teachers frequently report college pre-service coursework did not prepare them in classroom management (Stough & Montague, 2015). A sample of 752 veteran teachers were surveyed. These veterans ranked classroom management, instructional planning, and behavior management as the three components necessary in a general education classroom (Stough & Montague, 2015). Despite this large study, classroom management strategies have failed to be added to the pre-service curriculum at most universities.

In 1980, researchers Glickman and Tamashiro described three all-encompassing approaches to classroom management (a) interventionist, (b) interactionist, or (c) non-interventionist (Stough et al., 2015). An interventionist is a person who believes children need to be externally regulated in order to elicit appropriate behavior. Interactionists are teachers who create behavior systems in their classroom using rules and reframed responses (Stough et al., 2015). Stough et al. (2015) state that non-interventionists believe that children will self-regulate and learn to behave fittingly.

Sixty-two educators were surveyed and asked the following question, “is it important to offer a separate course in classroom management or behavioral intervention”

(Stough et al., 2015). Ninety-two percent of the respondents felt such a course was extremely important; however, none of them received that training prior to beginning teaching. The teachers participating in this research reported learning the most about classroom management from student teaching, substitute teaching, or teaching their own students. One hundred percent of the respondents reported a course on management pedagogy should be a requirement for special and general education teachers (Stough et al., 2015). If a course were to be added to the university curriculum, it would be beneficial to understand what should be studied. A research review found the following to be of value PBIS, and Response to Intervention (RtI). In many states, this is called a multi-tiered system of support (MTSS).

### **Multi-Tiered System of Support**

Sugai and Horner (2012) state that both PBIS and RtI are focused on a strong relationship between the teacher and student. This means the teacher needs time to build a relationship both academically and behaviorally with each student. Sugai and Horner (2012) state nor PBIS or RtI are boxed or canned programs, they are systemic changes that occur within the framework of the school by building relationships of trust and understanding. Although each is implemented in hundreds of thousands of schools around the world, no two implementations are exactly the same because no two schools are exactly the same.

In a single case study by Nuoffer (2013), the study explored different strategies to develop relationship building. The study found that changing negative behaviors to positive behaviors improved with building on the relationship with the student and the adult (Nuoffer, 2013). Speaking out in the classroom for a student means they have

confidence. A student will gain confidence through having a positive relationship with the teacher. McBain and Mhunpiew (2014), found a high correlation between student success and the number of positive interactions between the student and the teacher. The study suggested the teacher create activities that would help promote confidence among the students, so they feel confident enough to participate in the classroom (McBain & Mhunpiew, 2014).

Allday, Bush, Ticknor, & Walker (2011) found teachers who greeted students at the door by making eye contact, speaking in a positive tone, and using the student's name in a positive way helped students feel confident and empowered enough to decrease classroom disruptions by 45-72%. At the door, teachers can deliver cues for tier two and tier three interventions. For instance, a student who is struggling with a math concept can have a QR code to scan at the door that gives a quick video tutorial of the day's concept to prep them in advance. The teacher can encourage this and even promote adherence to this by giving behavior specific praise when the student is witnessed engaging in this behavior. Perhaps a student is engaging in personal space invasion with peers. The teacher can remind the student of their secret code. A secret code might be the teacher tapping his or her forearm with his or her index finger as a reminder to stay outside a person's personal hula-hoop space boundaries. These are the types of interventions that can help build confidence for a student (Allday, Bush, Ticknor, & Walker, 2011).

**Positive behavioral interventions and support (PBIS).** Research by Crone, Hawken, and Horner (2012), provide step-by-step guidelines to provide teachers to give daily behavioral feedback. This feedback provides relationship building information that informs the student the expectations and the exemplars of those expectations within the

context of the teacher's classroom. Positive behavior support suggests that teaching a student through positive role modeling what the appropriate behavior looks like, sounds like and feels like will help the student exhibit appropriate behavior (Horner & Sugai, 2012). A relationship can be established with positive communication between the teacher and student. Moore-Partin, Robertson, Maggin, Oliver, and Wehby (2011) report that in PBIS, the classroom guidelines are set for the prevention of targeted behaviors and the interventions are provided for support of the replacement behaviors. Individual positive prevention and pre-planning with the student will allow the student an opportunity to respond and reduce the behavior burst (Moore-Partin et al., 2011). PBIS is one sample of a multi-tiered system of support (MTSS).

PBIS has three tiers of intervention. The first tier is either called the universal tier or tier one (Horner & Sugai, 2012). The second tier is either called secondary, targeted, or tier two. The third tier is called tertiary, intensive, or tier three. All students receive universal support. Some students receive universal and targeted support. A few students receive universal and tertiary support when targeted support fails to ameliorate behaviors for that student (Sugai & Horner, 2012). As evidenced by numerous studies, PBIS is a systemic change that focuses on differentiating the interventions based on the needs of the students. It is also a very data-based process which focuses on making data-based decisions at all three tiers.

Universally, PBIS relies chiefly on office discipline referrals to determine movement from the universal level to the targeted or secondary level of intervention (Haraway, 2012). Many schools use a program called the School-wide Information System (SWIS). This program is a web-based program that graphs data focusing each

month on what is known as the big six. The six areas of focus are (a) location, (b) time of day, (c) problem behavior, (d) office discipline referrals per day per month, (e) day of the week, and (f) individual student (Sugai & Horner, 2015). Schools can run data to determine which students have 2-5 office discipline referrals and which students have six or more office discipline referrals. These numbers are the recommended breaking points for tier two and tier three interventions.

At the secondary or targeted level, there are several recommended strategies for intervention, including check-in/check-out (CICO) and/or the Behavior Education Program (BEP). CICO is a research based strategy calculated to boost the student through a relationship with a preferred adult who ensures the student is ready for the day. This person gives the student a checklist used each hour to ensure adherence to the expectation guidelines set forth in the school (Haraway, 2012). At the end of the day, the student checks-out with the preferred adult and tallies their scores on maintaining appropriate behavior. These scores are reported to the parent (Haraway, 2012). The BEP is a modified program similar to CICO. Some schools have tied a token economy to the behavior rating sheet.

The third tier of support which is called intensive or tertiary is typically determined by a functional behavior assessment (FBA) conducted by school personnel (Haraway, 2012). The FBA provides the school team with data to determine the triggers and functions behind the behavior. After the FBA is completed, schools typically develop a competing pathway model for behavioral intervention (O'Neill & Albin, 2014). In an FBA, it is imperative that baseline data are collected and compared to the treatment or

intervention (O'Neill & Albin, 2014). It is also important to ensure the interventions are research-based strategies (Haraway, 2012).

**Response to intervention (RtI).** Response to intervention (RtI) is a term frequently used in education to address either the academic or academic and behavior interventions in a multi-tiered system of support (Haraway, 2012). Researchers focus on relationship building within the RtI model as well. RtI focuses on differentiating instruction for academics based on a three tier model. All students receive the universal instruction. Some students receive targeted instruction and small number of students receive intensive instruction (Haraway, 2012). As in PBIS, RtI is a systemic change that focuses on tiered interventions based on the needs of the students.

Some school districts refer to RtI as RtI academic and RtI behavior. Other states have adopted names that stand for both sides of the tiered system to match the unique characteristics of that state. For instance, Oklahoma calls their academic and behavior tiered system of support the Oklahoma Tiered Intervention System of Support (OTISS) ([www.otiss.net](http://www.otiss.net)). Kansas references the tiered system of support as MTSS (<http://www.kansasmtss.org>). Missouri refers to the behavior portion as (<http://pbissmissouri.org/>) and the academic portion as RtI (<http://www.rti4success.org/missouri>). These names across the United States stand for the same intervention system and all focus on differentiating academic and behavioral instruction for each student. This would encourage relationship building between the teacher and the student to ensure each understand the other.

Many times, it hard to determine if the academic need caused the behavioral issue or the behavioral need caused the academic issue. This is why MTSS strategies that

include both academics and behavior are important. Imbeau and Tomlinson (2012) stated in a single subject study a teacher should allow for time, space, materials, groups, and strategies to begin shaping behavior in the classroom. Imbeau and Tomlinson (2012) designed, monitored, and modified a study around the needs of a student who portrayed disruptive behavior in the classroom. The student became overwhelmed with the visualization of seeing too many problems on their worksheet. The student's behavior was disruptive in that they were pushing away their work and shutting down (Imbeau & Tomlinson, 2012). The purpose of the study was to use differentiated reinforcement to allow the student to make a choice on his or her own to encourage active participation (Imbeau & Tomlinson, 2012). Imbeau and Tomlinson (2012) found the student willing to work on worksheets when the activity was created around their need.

Dimitriadis, Prieto, and Asesio-Perez (2013) found teachers can manage their classroom more effectively by allowing students to have the necessary tools to reach their full potential. Teachers need to provide tools or designs that will be effective for students to have choices (Dimitriadis et al., 2013). Choices allow students to have a meaningful education. Dimitriadis et al. (2013) gathered a group of teachers and provided a day in a classroom ecosystem that offered environmental choices. Teachers were given different scenarios on how to accommodate certain situations with different students. Allowing the participants, a hands-on experience showed each of them how they can provide a solid education for students by providing equal choices (Hamlett, Carr, & Hillbrand, 2016). While the author did not dwell on the difference, it is important to note equal choices is not threatening a student. "Do this or lose recess is not an equal choice." An equal choice

might offer a student a bean bag chair or a stability ball, an air-filled disk or a stadium cushion, a standing desk or a bar stool at a raised desk.

### **Summary**

Teachers report not having enough strategies from preservice training to deal with behavioral issues that occur in the classroom (Froelich et al., 2012). Understanding the needs of individual students was cited as one of the most empowering interventions provided post-graduation (Froelich et al., 2012). When developing research strategies for students who have inattentive behaviors or out of seat behaviors that can disrupt the learning, it is imperative to have a clear description in measurable and observable terms when being exhibited (Haraway, 2012). This is called the stranger test, meaning everyone will rate the behavior the same no matter who is collecting the data. One person's definition of off task might not be the same as another person.

Guardino and Fullerton (2010) found that teachers would spend more time teaching effectively if there were fewer disruptions in the classroom. Classroom management is important and most effective if a teacher uses proactive strategies to decrease disruptions (Guardino & Fullerton, 2010). Guardino and Fullerton (2010) put three steps in place for changing the environment within the classroom. They are (a) observe, (b) modify, and (c) follow-up (Guardino & Fullerton, 2010). Observing includes looking at what are the disruptive behaviors, modify is making adjustments to the classroom space, and follow-up is going back to the changes to see if additional modifications need to be made (Guardino & Fullerton, 2010). Modifications are made to work with the classroom that is achievable and less interfering for fewer disruptions (Guardino & Fullerton, 2010).

If classroom management is well controlled and a few students are still struggling with academics and/or behavior, then this research study on the provision of dynamic seating may prove beneficial. Many research articles have found positive attributes with the use of dynamic seating or movement in the classroom (Burgoyne & Ketcham, 2015; Cardini et al., 2013; Carlson, Rowe, & Curby, 2013; Carter & Stephenson, 2015; Clemes et al., 2015; Commissaris et al., 2014; Efrat, 2016; Faramarzi, Rad, & Abedi, 2016; Fede, 2012; Fedewa et al., 2015; Fedewa & Erwin, 2011; Freitas & Ferrara, 2015; Goodmon et al., 2015; Guardino & Fullerton, 2010; Jaggi, Bakhshi, & Sandhu, 2013; Kercood & Banda, 2012; Kilbourne, 2011; Kuhn & Lewis, 2013; Lang et al., 2012; Moyer & Savino, 2015; Murray & Ramstetter, 2013; Perera et al., 2015; Pfeiffer et al., 2008; Pfeiffer et al., 2014; Reilly, Buskist, & Gross, 2012; Rhea, 2016; Richardson et al., 2016; Rotz & Wright, 2013; Sadr et al., 2015; Schaaf et al., 2015; Schoen, Miller, & Hampton, 2014; Schult et al., 2013; Schwabova, Maly, & Zahalka, 2015; Smith-Roley et al., 2015; Wan Yumus et al., 2015; Wang et al., 2014; Wu et al., 2012; Zimmer & Desch, 2012). Given the inexpensive cost to creating dynamic seating using air-filled disks and the positive outcomes reported through many research articles on decreased disruptions and increased on-task behavior, the literature would suggest this research project is well supported. Children are reported to have decreased outdoor play time due to increased use of technology (Efrat, 2016). Furthermore, schools are decreasing the amount of time students engage in physical education classes and recess (Becker, 2013). This lack of movement needs to have an outlet in order to produce academic and behavioral success. Dynamic seating is one component which appears to provide some of the movement necessary for learning (Kuhn & Lewis, 2014).

Positive correlations between dynamic seating and academic achievement have been found in numerous studies. The addition of air-filled disks to static chairs is the most cost-effective solution to the classroom ecosystem. A secondary benefit to the air-filled disks are the distraction factor. Sit to stand desks cost over \$324 per pupil from Safco products. Anti-burst stability balls cost approximately \$30 per pupil for the inexpensive ones with no base from GoFlx. When the base is added to the stability balls the cost rises to approximately \$80 per pupil from Gaiam. The air-filled disks are \$12 per pupil from Isokinetic. The sit to stand desks are not 100% quiet when being raised or lowered. This would undoubtedly cause some auditory distractibility in the classroom. The anti-burst stability balls will roll away when the student gets up to walk across the room. This would undoubtedly cause a visual distraction in the room as the student goes to retrieve the ball. The air-filled disks will not make noise and will stay in the chair when the student rises to turn in work or participate in a group activity.

The students most likely to benefit from dynamic seating are those with sensory integration issues and these could include students with ADHD, LD, and approximately one in six students who have SPD. As Froelich et al. (2012) found in her research, the interventions used for students with disabilities are just as effective at changing the behavior of students who are considered neuro-typical. The three primary disabilities or disorders taught in the general education classroom are ADHD, LD, and SPD. These disabilities or disorders account for approximately 38% of the general education population (9%, 13%, and 16%) (NCES). Research indicates educator understanding of the implications of having ADHD, LD, and SPD are imperative to designing interventions to ameliorate behavior.

### **Chapter 3: Research Method**

Research indicates students need to engage in proprioceptive and vestibular input in order to engage their vestibular system (Burgoyne & Ketcham, 2015). When the vestibular system is engaged, it enhances pro-social in-seat behavior (Fede, 2012). The purpose of this quantitative quasi – experimental study was to determine if the addition of dynamic seating to standard static chairs provided enough proprioceptive input to decrease classroom off-task behaviors. This was a natural quasi-experiment due to the nature of classroom assignments and availability of students. A quasi-experimental group means the group assignment is not random in the traditional experimental type of design as the students were all fourth graders from the same economic background (Derue, Nahrang, Hollenbeck, & Workman, 2012). A qualitative method would use narrative responses based on the opinion of others (Berg & Lune, 2012). In this scenario, the others would be students. Student opinion was not sufficient for measuring the outcome of environmental design on decreasing inappropriate behaviors (Sargeant, 2012). Perception is not an accurate descriptor on the effectiveness of this intervention on the classroom. This study addressed some simple intervention educators can use to gain more time on task by decreasing classroom off-task behaviors which impede learning. A control group of fourth grade students at the same location were used for comparison.

#### **Research Methods and Design**

A quantitative quasi-experimental research design was used for this study. Quantitative research is objective and measures results using statistical data collected through the analysis of pre-existing baseline data compared to post-intervention data (McCusker & Gunaydin, 2015). The relationship between an independent variable and an

outcome are best determined using quantitative analysis (McCusker & Gunaydin, 2015). Quantitative data also allows researchers to make generalizations across groups of people and in the case of this study, across groups of students (Mayes & Koballa, 2012). Quantitative research can be descriptive or experimental (Mayes & Koballa, 2012). Descriptive data typically means the subjects were measured once and experimental data means the subjects were measured before and after the introduction of the independent variable (McCusker & Gunaydin, 2015).

Qualitative research does not manipulate variables to ascertain the reliability of a hypothesis (Berg & Lune, 2012). Rather, qualitative research is focused on understanding social settings as the analysis is derived from participant responses (Berg & Lune, 2012). The focus of qualitative research is on recordings of human conversations whereby participants divulge their interpretation of their surroundings (McCusker & Gunaydin, 2015). Qualitative research seeks to see the world through the lens of the participants (McCusker & Gunaydin, 2015). Typically, qualitative research consists of interviews or observations without manipulation by the researcher (McCusker & Gunaydin, 2015).

The opinions of fourth grade students was not sufficient for measuring the environmental design on decreasing targeted behaviors (Sargeant, 2012). Therefore, a qualitative research method was considered but rejected, due to the lack of fidelity in using fourth grade student responses (Berg & Lune, 2012). The acuity of perceptive awareness in young students is not an accurate descriptor on the efficacy of this classroom intervention. A quantitative data analysis allowed for an analysis of pre and post intervention to determine the effectiveness of this independent variable on fourth grade student grades and disruptive behaviors.

The use of quasi-experiment methodology involves a group assignment that is not random, such as natural placement of students in a classroom (Derue, Nahrang, Hollenbeck, & Workman, 2012). The students in this study were fourth graders who resided in one of six subdivisions, including one apartment complex that feeds into a local school. This makes the study a natural quasi-experiment due to the makeup of assigning classes and the availability of students in a general location. A control group of similar fourth grade students at the same location were used for comparison.

Educators will be able to procure the design elements of this research study and implement the dynamic seating in similar settings. Further studies will be able to determine if the effectiveness of this intervention is generalizable to other elementary or secondary groupings. Fidelity of implementation and design of data collection is simplistic for any reader to duplicate for their own purposes. Using high validity measures, teachers will be able to determine the validity of this design and ensure the likelihood of transference to their setting (Phillips, 2014). As practitioners, educators can assume the research was portrayed under inimitable social conditions that are similar but not completely replicable to their setting (Heikkinen, Huttunen, Syrjala, & Pesonen, 2012).

### **Population**

According to the National Center for Educational Statistics (NCES), there are 66,718 elementary schools in the United States (NCES, 2016). According to the Census Bureau, the following states comprise the Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin (Census Bureau, 2016). According to the NCES (2016), there are 10, 479,600

students in elementary and secondary education in 2015 in the Midwest. The Midwest school district for this research consists of 35 elementary schools. At the time of the study, the specific school for this research had approximately 520 students with an average class size of 24 students. This population is generalizable to most suburban school districts across the United States. There are approximately 3,700,530 fourth grade students in the United States (Census Bureau, 2013). Of the 29,567 students enrolled in the research study school district, 2,321 were fourth grade students (NWEA, 2015). The research school site is the largest school in the district and at the time of the study fourth grade had the highest number of students in all the elementary schools for this district (NWEA, 2015).

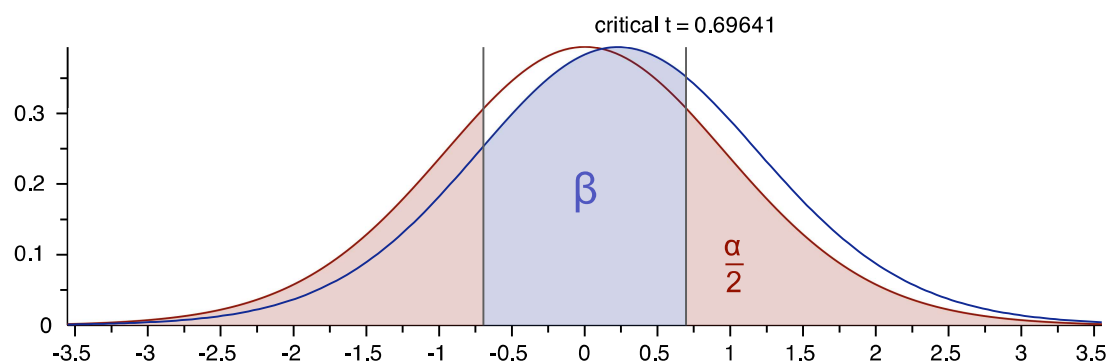
### **Sample**

The participants who received the treatment were determined by conditions beyond the control of the experimenter; the sample was one of convenience. The intended sample size was approximately 45 fourth grade students who attended an elementary school in a suburban district in the mid-west. The actual sample was nine students in the control classroom and 17 students in the experimental classroom. These students were dependents from median income households with over 95% of the students residing in a two-parent family structure. This district had a 98% graduation rate with education being important to the families as indicated by their school involvement. Approximately 27% of the students in this study had an IEP or a 504 plan with 19% identified as ADHD. This is a convenience sample (Costanza, Blacksmith, & Coats, 2015). This group was chosen directly because the educator in charge had full control of the classroom environment. The building administration was in full support of this research. District approval was

sought through the building administrations' support.

There were 109 fourth grade students in this school. Of these 109, there were 59 girls and 50 boys. In the fourth-grade group, the ethnicity ratio was 91% Caucasian, 2% African American, 3% Asian, and 4% who chose not to share ethnicity. Ninety-eight percent of these students resided in homes with two parents. This school district also collected data on whether or not the parents had attended and graduated from college. Ninety-nine percent of fathers of fourth graders had attended and graduated from college. Approximately, 85% of mothers of fourth graders graduated from college.

Statistical significance was conducted based on the actual students available in the convenience sample. Utilizing a T-test correlation statistical power analysis, the effect size was determined. The standard error of distribution is decreased with sample size; however, the sample size is limited in this experiment due to convenience samples. Utilizing a T-Test criterion correlation power analysis with an estimate of 22 students, with the power set at .50 and an error of probability set at .05, the effect size was .70. This would be a medium effect size according to Cohen's Rules (Liu, Xiaofeng & Steven, 2015). Figure 1 refers to the statistical power analysis.



*Figure 1.* Power Analysis.

This graph refers to the T-test that was used to determine the effect size.

There were 26 students who were part of the research. Seventeen of the students were in the experimental classroom and nine students were in the control classroom. The sample size was determined by the number of signed and returned consent forms. As previously noted, there was a 55% return rate between both classes for signed consent forms. Parents were conservative in their views for allowing children to be participants in research.

### **Instruments**

Primary data sources for the study included a tabulation grid for observations of off-task behavior and the collection of student grades in the subject areas of writing, reading, and math. The study included a three-week collection of baseline data and six-week collection of intervention data for two classrooms of fourth grade students in a Midwest suburban district. The control group had 9 students and the experimental group had 17 students. Data were tabulated using a frequency grid prepared by the researcher with randomly assigned numbers given to each student to ensure confidentiality in reporting (Liu, 2015). The researcher used videotape of both classrooms to ensure consistency of marking behaviors between the control and experimental classroom. Systematic direct observation frequency data has been a well-regarded data collection tool since the early 1900's (Stichter & Riley-Tillman, 2014). Table 1 shows the increments of time and student numbers.

Table 1. *Data Tabulation Sheet*

Date: \_\_\_\_\_

Student	8:20-9:20	9:21-10:20	10:21-11:20	11:21-12:20	12:21-1:20	1:21-2:20	2:21-3:20
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							

Note: Use the following scoring grid for accruing tabulations of off-task behaviors. Each student has been assigned a random number to avoid identification in reporting. The remaining columns denoted time from 8:20 a.m. to 3:20 p.m. in hour increments. By delineating hourly times of day, the researcher will be able to discern if the off-task behaviors are more prevalent at certain times of the day. As off-task behaviors occur in the classroom they will be tallied on the coordinating grid. Off-task behaviors are defined as (a) out of seat, (b) off-topic discussions, (c) blurting out of turn, or (d) lack of task commitment. Observer drift will be minimized by videotaping the entire day and marking behaviors as witnessed on the tape after school is dismissed each day. The data will then be transferred from the grid to an Excel spreadsheet. The Excel program will allow graphs and calculations to be performed easily.

Off task-behaviors were measured as defined in measurable and observable terms used by the recorder. Data were gathered on off-task behaviors utilizing a wide-angle video camera in the room and observed post instruction. Grades were recorded utilizing district standards in three subject areas (a) reading, (b) mathematics, and (c) writing. District standards were recorded in percentile ranks based on either rubrics or district designated questions per the curriculum. Items that were recorded were daily assignments that were worksheets, quizzes, tests, projects, and discussion contribution in the subject areas. The videotaping alleviated a third party sitting in the room which could change normal behaviors (Sedgwick & Greenwood, 2015).

After the three weeks of baseline data, and a one week introduction of the air-filled disk for the experimental group, six more weeks of intervention data were collected. A one-way ANOVA helped determine the effectiveness of adding the dynamic seating to static seating on on-task behavior and academic performance. A one-way repeated ANOVA is a statistical test which compares multiple criteria with a correlated groups design (Jackson, 2005). In this study, the comparison was between two fourth grade classrooms of similar gender and abilities in a Midwest suburb with one receiving treatment and the other being the control group. The analyses compared the difference in off-task behavior as well as reading, writing, and mathematical performance.

### **Operational Definition of Variables**

Each component for this research is defined as it relates to the investigation.

**Variable One. Off-task behaviors:** For the purpose of this study, off-task behaviors are major events that impedes the learning environment or takes the student off

the task assigned (Algozzine et al., 2012). Any off-task behavior is counted in the frequency grid if they are not doing the activity as directed.

**Variable Two. Seating:** For the purpose of this study, the seating is defined as that provided by the Local Education Agency (LEA) as a hard-plastic chair with metal legs and back supports (Guardino & Fullerton, 2010).

**Variable Three. Air-filled Disks:** For the purpose of this study, the air-filled disks known as exercise disks were added to the seating. They were procured through a vendor and of the type typically used for exercise. These disks are flat and filled with an adjustable amount of air with a bumpy surface on one side and a smooth surface on the other side (Fedewa & Erwin, 2011).

**Variable Four. Academic Achievement:** For the purpose of this study, the academic achievement was defined as the grades earned in the core subjects of reading, math, and writing. Scores were derived using district standards for comprehension, calculation, and six-trait writing.

### **Data Collection, Processing, and Analysis**

For this study, data were collected using a data collection form and student grades from teacher grade books. To ensure student understanding of classroom expectations, the positive behavior support framework of Teach, Model, Practice, Praise were utilized as a beginning of the year structure (Sugai & Horner, 2015). The first five weeks of classroom management focused on building relationships and understanding the expectations of the group. Waiting for at least five weeks before beginning data collection ensured the students would have a solid understanding of the universal expectations of the school and classroom, and have become a cohesive group with each

other. The researcher began data collection for classroom off-task behaviors by collecting baseline data for three weeks. Data were tabulated and recorded as baseline data. Grades were recorded for three weeks to establish baseline data on daily grades in reading, writing, and mathematics.

The researcher utilized a form to collect baseline data on disruptive behaviors that stop the learning process. After three weeks of baseline data collection, dynamic seating was added to each student's chair and sewn in using fabric. This eliminated the cushions falling off the chair, flying across the room, or sticking to the student's legs. The data collection form consisted of eight columns for data collected for three weeks of baseline data and six weeks of intervention data. The first column lists each student's coordinating number. The secondary columns denoted one hour of time throughout the day beginning with 8:20 a.m. to 9:20 a.m. The video of the classroom was used for data analysis which was compared to real-time for each hour of data collection. As off-task behaviors occurred in the classroom, the researcher made a tally in the coordinating column and row for the student engaged in the disruption. At the end of each day, the researcher transferred these tallies into an excel spread sheet. Totals were recorded for time of day, day of the week as a whole, and by student number. These totals were compared from baseline to intervention (see Appendix A).

Student grades were also collected from the teacher gradebook and from state testing for winter and spring in the subjects of reading, math, and writing. This information was entered into an Excel spreadsheet. Grades were collected daily utilizing district mandated assessment tools. All classroom teachers in the fourth grade across the district used the same instructional tools and methods. These grades were totaled for each

student and used for comparison to baseline grades. Cumulative grades by class and by student number were compared between baseline and intervention data.

After three weeks of baseline data and one week of introduction to the treatment, intervention data were collected by the researcher using the same checklist as used for collecting baseline data. The students were given the dynamic seating on the first day of the introduction week. Data were recorded using a researcher developed frequency grid for a total of nine weeks with three being baseline, no data collected in either classroom during the introduction week, and six weeks of intervention data in both the control and experimental classrooms. These data were tabulated using the same excel spreadsheet format and compared using bar graphs for time of day, day of the week, and the three core subjects. Totals were collected averaged by number of students in each group, and by individual student in the same format used for baseline data tabulation.

For ease of recording data in the tallying phase, the original student numbers were used. When this information is transposed into Excel, the numbers were given random assignment to assure anonymity of each student. The same random numbers were kept for each student throughout both phases of this data collection. This ensured the identity of each individual student is not apparent to anyone reading the research. As random student numbers were used as identifiers rather than names, anonymity and confidentiality were ensured. Only the researcher knew the number for each student. The data were stored in a locked file cabinet in a locked office of the researcher. Data was not stored on the hard drive of the computer, but instead placed on a password encrypted flash drive. The password encrypted flash drive is where the list of students and their numbers would be found.

Analysis of data involved a comparison of baseline and intervention data between two similar fourth grade classrooms to determine the percent of increase or decrease in classroom off-task behaviors and academic achievement. Grades in the core subjects of reading, math, and writing were compared at the pre and post intervention phases. Running multivariate tests within Multivariate Test in ANOVA using the program SPSS and selecting equal variances assumed, the following tests were run (a) Pillai's Trace, (b) Wilks' Lambda, (c) Hotelling's Trace, and (d) Roy's Largest Root. The following options were chosen (a) descriptive, (b) homogeneity of variances, (c) Brown-Forsythe, (d) Welch, and (e) Means plot, the ANOVA determined the effect of the treatment on classroom performance. Utilizing the seating as the independent variable or the factor and the performance in the classroom as the dependent variable a one-way repeated ANOVA was performed to determine the effectiveness of dynamic seating on classroom performance.

### **Assumptions**

The first assumption was the ability to match the typical classroom size in the United States. According to national data, the typical classroom is comprised of 22 students (NCES, 2012). The experimental classroom in this study did indeed consist of 22 students. However, this classroom size could have changed at any time as the district involved is a highly-sought area with many new subdivisions which feed into this elementary school. During the study, data were collected of 17 students, with no new students added to the classroom size.

The second assumption of this study was regarding the learning needs of the students in the classroom. Within any classroom, students acquire knowledge in different

modes depending on their strengths and weaknesses. One area of concern is that of learning disabilities (LD), which the National Center for Educational Statistics (NCES) reports is as many as 13% of the student population (NCES, 2014). This would account for approximately three students in the classroom who are diagnosed with some form of a learning disability. This could be in the form of dyslexia, dyscalculia, dysgraphia, or dysphasia, which is commonly referred to as aphasia in the United States. Students with differing abilities need assurance their strengths and weaknesses are being met by the educational structure of the classroom. The experimental classroom of study had three students who qualify as students with learning disabilities; therefore, the classroom did mimic the national norm.

The third assumption regarding national norms is that many students struggle with sensory processing disorders (SPD). Research indicates that one in six students may have a sensory processing disorder (Schoen, Miller, & Hampton, 2014). This would also account for three children in a classroom of 17 students. Students with SPD are considered to be in on a spectrum with some severely affected and others only mildly affected. The classroom teacher must account for all students through accommodations in the environment. Based on the national average and discussions with parents of the study students, there were three such students in this classroom.

The fourth assumption lies in the students diagnosed or displaying the characteristics of Attention Deficit Hyperactivity Disorder (ADHD). The national average reports 9% of the student population either have or exhibit the characteristics of ADHD (NCES, 2014). There are three types of ADHD (1) ADHD with hyperactivity and

impulsivity, (2) ADHD inattentive, and (3) ADHD combined. This would account for two students in an average classroom. The study classroom had two such students.

With these statistics in mind in a typical classroom, approximately nine of the 17 students in the study might of had issues that could interfere with learning which could benefit from the integration of sensory modulation techniques into the classroom (Goodmon, Leverett, Royer, Hillard, Tedder, & Rakes, 2014). The classes used for research appear to follow the national statistics for average number of pupils and students with learning difficulties. The number of experimental fourth grade students in the class with signed permission forms was comprised of 17 students, which are 11 girls and six boys. This would be a ratio of 65% female and 35% males for the experimental group with signed permission forms. The number of fourth grade students in the control classroom with signed permission forms was six girls and three boys as well. The percentage of signed permission forms in the control classroom was 66% female and 33% male. The National Center for Educational Statistics (2012) reports the national average is 49% girls to 51% boys. The experimental and control classroom were slightly biased by girls to boys. The experimental classroom was 51 % female to 49 % male, so it is inversed of the national population.

If nine of the 17 students have learning issues as noted above, this would account for 41% of the classroom. Based on national averages, the two classrooms being used for control and experiment were good choices to make some generalizations to the educational community. The interventions were offered to all students in the experimental class and therefore addressed the benefit to all students despite abilities.

## **Limitations**

Many research studies of the single subject research variety consist of four students within the study. This study utilized nine students in a control and 17 students in the experimental classroom grouping. Ideally, the study would be replicated within an entire school or district; however, the limitations of a lone researcher make this an impossible task. The generalizability of this research study should encourage others in the field to replicate the study beyond previous research and perhaps conduct a large-scale study beyond the scope of two classrooms.

Another limitation of this study is the fact that only fourth graders were utilized in this study. Ideally, the study would consist of kindergarten through twelfth grade students to determine the likelihood of improvement on a grade by grade basis. Research conducted on elementary students is typically not viewed as viable in a secondary classroom; therefore, research conducted across all grade levels would be the ideal format. This research study was limited to only fourth grade viability.

A third limitation of this study is the fact that the school of focus was within a suburban location for students of middle to upper-middle class socio-economic status (SES). This limited the ability of the study to be applicable toward urban, rural, and lower economic status students. The free and reduced lunch status of the research school was at the time of the study very low. It is not a Title-One school.

A fourth limitation of this study was the fact that the teacher could not pick and choose the gender or ability level of any of the students who were randomly assigned to the classroom. While the ability levels of the students were on par with the national average, the gender equivalents were slightly askew compared to the national average.

An ideal situation would be to match the national average on gender and ability levels; however, very few educators have the power to choose their students.

### **Delimitations**

This study focused on two fourth grade classrooms with one control group and one experimental group. The study employed a baseline data collection on student off-task behaviors compared to post intervention data using the same student disruption qualifiers. Student off-task behaviors were classified as inappropriate out of seat behavior, fidgeting in a way that disturbs the learning environment, and/or blurting out of turn. The study was intended to start six weeks from the start of school, however, due to limitations out of this researcher control the study began 24 weeks from the first day of school. This allowed the students to adjust to their new environment prior to the collection of baseline data.

Frequency data of off-task behaviors was collected on the control and experimental group. Infractions were counted and totaled for each hour of the day. Hourly numbers were added and calculated as baseline data. After the introduction of the air-filled disks in the student chairs, data continued to be collected to quantify the number of off-task behaviors that occur on a daily basis by the hour. These numbers were added to compare to pre-intervention data (Grant & Osanloo, 2014). A decrease from baseline data were derived from using a repeated measures of variances ANOVA on academic performance in reading, mathematics, and writing as well as classroom off-task behaviors.

Concurrently with classroom off-task behaviors, the students' grades were averaged prior to the beginning of the intervention data. At the end of the intervention

data collection, the grades were collected and averaged again for each student. An analysis of grades were utilized by comparing each student to themselves and then as a whole. The student identity remained anonymous; however, their pseudonym data were reported.

Baseline data were collected during weeks 24 through 27 of the school year. This gave three weeks of baseline data for grades and off-task behaviors. Each student's pseudonym in the control and experimental class were recorded by the hour for off-task behaviors and by the subject for grades in core subjects. An average for each student was tabulated at the end of the three weeks of data collection for the experimental and control classes.

During week 28, the students were introduced to the air-filled disks in the experimental class. Data was not collected in the experimental class during this phase and therefore were not collected in the control class. This allowed for the experimental group to adjust to the new dynamic seating and not interfere with data collection. Expectations for the seating adjustment were taught to the students.

During weeks 29 through 34, the data collection commenced in the exact same manner as weeks 24 through 27. Data were collected in the control and experimental classes. Grades continued to accrue and be recorded for all students in both classrooms. An average of the grades and off-task behaviors were conducted from the hourly tabulations. These scores were compared to the baseline data to determine if the hypothesis was correct.

### **Ethical Assurances**

Ethical assurance was obtained by seeking approval from the Institutional Review Board (IRB) of Northcentral University and the participating school district. Once approval was obtained from the school district, approval to conduct the study at the intended school was asked of the principal of the school. Teacher consent (Appendix B) and parental consent (Appendix C) of students in the intended classrooms were then obtained. A de-briefing meeting was set-up with parents and teachers to allow each member to ask questions of the researcher. Data was not collected until approval had been granted by the IRB. Once all consent forms have been obtained, data collection began. Confidentiality of all participants was made possible by signing each student a number. Each student was only referenced by their number. Researcher bias was minimized during data collection and analysis, that in a way were fair to all participants.

### **Summary**

The purpose of this quantitative quasi – experimental study was to determine if the addition of dynamic seating provided enough proprioceptive input to decrease classroom off-task behaviors. The hypothesis of this research proposed student behavior is directly related to the amount of proprioceptive input received by being seated in a hard-plastic chair for approximately seven hours each day. The fourth-grade sample chosen is an age where students are expected to remain seated for long periods of time (Clemes et al., 2015). The Local Education Agency (LEA) in this mid-west city uses hard plastic chairs as standard seating in all classrooms. The sample consisted of 9 fourth grade students in the control classroom and 17 fourth grade students in the experimental classroom who were randomly assigned using criteria beyond the control of the

researcher. Calculating a one-way repeated ANOVA test determined the effectiveness of the introduction of dynamic seating to the current student chair. The intention of this study was to find a correlation between proprioceptive input, academic achievement, and classroom off-task behaviors.

## Chapter 4: Findings

This quantitative quasi – experimental study investigated the impact of air-filled disks added to static chairs on the off-task behaviors and academic achievement of fourth grade students in a Midwest suburban school. Invitations to participate were mailed out to 23 parents in the control classroom and 24 parents in the experimental classroom. Parents were notified via email to expect informed consent letters in the mail. Parents were asked to discuss and talk to their children. If they chose to participate, they were to sign the parent consent and have their children sign their consent and return these to school. Several reminders went out to all possible participants. Of the 47 invitations to participate that went out, nine were signed and returned in the control classroom and 17 were signed and returned in the experimental classroom (see Appendix A and B for the consent forms). This was a 55% participation rate for the return on responses.

Data collection began on January 31, 2017 and continued until February 17, 2017. For both classes this time period was considered baseline data collection. The air-filled cushions were introduced in the experimental classroom for one week. Giving students one week to adjust to the air-filled cushions allowed each student to determine how they wanted to use the cushions (a) not at all, (b) bumpy side up, (c) smooth side up, (d) flipped up as a backrest, and (e) the amount of air they desired. All students in the experimental class were given the cushions. The cushions were sewn into seat sized pockets and attached to the chair with a ribbon to alleviate any sliding issues. One student elected to not have a cushion, and was therefore not in the data collection. One other student chose to use the cushion as a backrest. This student also was not included in the

data collection. No data were collected in either classroom during this week of introduction to the air-filled cushions.

Data collection began again on February 27, 2017 and continued through April 13, 2017. Data were collected in both classrooms. Data collected during this period were considered intervention data for both groups. Data were collected for baseline and intervention through videotaping of both classrooms. This insured fidelity of analysis and allowed the teachers to teach during the day without stopping to record data. Data were transferred each evening from that day's taping in each classroom to the researcher-developed excel spreadsheet collection tool for data analysis.

## **Results**

This section is organized by variables that were collected during observations: (a) off task behaviors, (b) academic achievement, and (c) social validity.

**Off task behaviors.** Data were collected for off task behaviors across the entire school day including lectures, group work, independent work, and small group work for both the 17 students in the experimental classroom and the nine students in the control classroom. Off task behaviors were defined as inappropriate out of seat behavior, fidgeting in a way that disturbs the learning environment, and/or blurting out of turn.

***Control classroom comparison of baseline to intervention.*** In the control classroom, Student D had the highest average of off task behaviors during baseline data collection with 79.08 per day. Student E had the lowest average off task behaviors during baseline data collection with 48.54 off task behaviors per day. The average off task behaviors for the control group during baseline was 65.75. Student D had 13.33 off task

behaviors above the average and Student E had 17.21 less off task behaviors per day than the average student in the control classroom.

During the intervention phase in the control classroom, Student D averaged the highest off task behaviors per day with 64.21. Student E exhibited the least behaviors per day with 54.89 off task behaviors during intervention in the intervention phase. The average off task behavior for the whole control class during the intervention phase was 60.05. Student D was 4.16 points above the average and Student E was 5.16 points below the average off task behaviors for the control classroom during the intervention phase.

Student I exhibited the highest gains in decreasing off task behaviors during the intervention phase in the control classroom. Student I presented a 23.91% decrease in off task behaviors from baseline to intervention. Student E exhibited the second highest gain in decreasing off task behaviors during the intervention phase in the control classroom. Student E demonstrated a 13.08% decrease in off task behaviors during the intervention phase in the control classroom. In the control classroom, the average for the whole class was 65.75 off task behaviors per day. Table 2 reports the averages for the control classroom from baseline to intervention phase.

Table 2. *The averages for the control classroom from baseline to intervention phase.*

	Range During Baseline	Average During Baseline	Range During Intervention	Average During Intervention	Percent Change Between Baseline and Intervention
Student A	45-94	73.08	42-87	62.18	-14.91%
Student B	55-93	77.30	41-91	61.64	-20.25%
Student C	32-103	73.85	39-91	58.71	-20.50%
Student D	60-102	79.08	40-95	64.21	-18.80%
Student E	30-67	48.54	26-82	54.89	+13.08%
Student F	36-98	65.77	44-87	60.64	-7.80%
Student G	38-100	71.54	35-93	60.36	-15.62%
Student H	30-72	53.15	36-73	56.54	+6.38%
Student I	34-66	49.46	37-81	61.29	+23.91%

In the control classroom, the range during baseline per student was 30-103 with the average for the class during baseline of 65.75 off task behaviors per day. Three students had an increase in off task behaviors in the control classroom ranging from a 7.54% increase to a 24.49% increase. Six students improved off task behavior during the intervention phase in the control classroom with a range of 7.48% to 20.27% decrease. The range during the intervention phase of the research was 26-95 with the average for the class during intervention of 60.05. There was an 08.67% decrease overall during the intervention phase in the control classroom.

***Experimental classroom comparison of baseline to intervention.*** In the experimental classroom during baseline data collection, Student QQ exhibited the highest off task behaviors during baseline with an average of 85.82 per day. Student AA

exhibited the second highest off task behaviors during baseline in the experimental classroom with an average of 81.09 per day. Student FF had the least off task behaviors in the experimental classroom during the baseline phase with an average of 53.73 per day. Student NN exhibited the second lowest off task behaviors during baseline with an average of 54.60 per day. During the intervention phase in the experimental classroom, Student AA exhibited the highest rate of off task behaviors with an average of 46.18. Student QQ was the second highest for off task behaviors during the intervention phase in the experimental classroom with an average of 36.25 per day. The lowest average off task behaviors during the intervention phase in the experimental classroom was Student KK with an average of 23.29 per day. The second lowest demonstration of off task behaviors during the intervention phase was Student OO with an average of 26.89 per day in the experimental classroom.

Student KK improved the most in the experimental classroom with a 66.86% decrease from baseline. Student PP was the second most improved student in the experimental classroom with a 57.99% decrease in off task behaviors between baseline and intervention. The least improved student still demonstrated a decrease in off task behaviors. Student AA displayed a 43.05% decrease from baseline in off task behaviors in the experimental classroom. Student NN revealed the second least improvement with a 44.80% decrease from baseline with the addition of the air-filled disk in the experimental classroom. The average decrease from baseline to intervention for the experimental classroom was 52.98%. Student KK was 13.88 points above the average and Student AA was 9.83 points below the average. Table 3 displays the ranges and averages across conditions in experimental classroom.

Table 3. *Summary Data for Off Task Behaviors: Ranges and Averages Across Conditions in Experimental Classroom.*

	Range During Baseline	Average During Baseline	Range During Intervention	Average During Intervention	Percent Change Between Baseline and Intervention
Student A	37-120	81.09	24-70	46.18	-43.05%
Student B	8-104	65.73	5-57	28.04	-57.34%
Student C	45-107	74.36	12-52	31.50	-57.63%
Student D	55-98	77.36	22-64	35.96	-53.51%
Student E	20-115	68.64	0-57	29.46	-57.08%
Student F	9-103	53.73	15-53	28.54	-46.88%
Student G	28-146	73.82	17-53	33.32	-54.86%
Student H	26-92	63.27	17-54	29.96	-52.65%
Student I	10-108	61.55	0-53	27.32	-55.61%
Student J	21-102	62.18	16-51	33.00	-46.93%
Student K	22-121	70.27	5-48	23.29	-66.86%
Student L	21-123	60.00	14-59	30.68	-48.87%
Student M	24-97	65.70	14-50	30.71	-53.26%
Student N	14-99	54.60	12-46	30.14	-44.80%
Student O	14-145	60.45	6-49	26.89	-55.52%
Student P	30-104	68.00	16-50	28.57	-57.99%
Student Q	49-126	85.82	19-72	36.25	-57.76%

In the experimental classroom, the range during baseline per student was 8-146 with the average for the class during baseline of 67.45 off task behaviors per day. No increase in off task behaviors occurred in the experimental classroom during the intervention phase of the study. The average off task behavior during intervention was 31.17 per day per student. Decreases in off task behavior ranged from 43.05 to 66.86% in off task behaviors during the intervention phase. The average decrease from baseline to intervention for the experimental classroom was 52.98% decrease overall.

***Conclusion of off-task behavior data.*** Data were collected in the control and experimental classrooms during baseline data collection and intervention data collection. The same criterion was used to determine behaviors which were counted as off-task behavior. Analysis of comparison between the control classroom and the experimental classroom showed favorable results. The following section will discuss the comparison for off-task behaviors between the control and experimental classroom with the addition of air-filled disks in the experimental classroom.

***Comparison of control classroom to experimental classroom.*** The control classroom had an 8.67% decrease from baseline and the experimental classroom had a 52.98% decrease from baseline during the same time-period. Both classrooms experienced the exact curriculum on the same days and experienced the same disruptions in school vacations and activities. Based on the similarities in classroom make-up, teaching structure, teaching style, and environmental factors the hypotheses on implementing an air-filled disk to a static chair. Figure 2 displays behaviors on the rise before the intervention in both classrooms and then a difference in off-task behavior between the two rooms after the intervention was implemented.

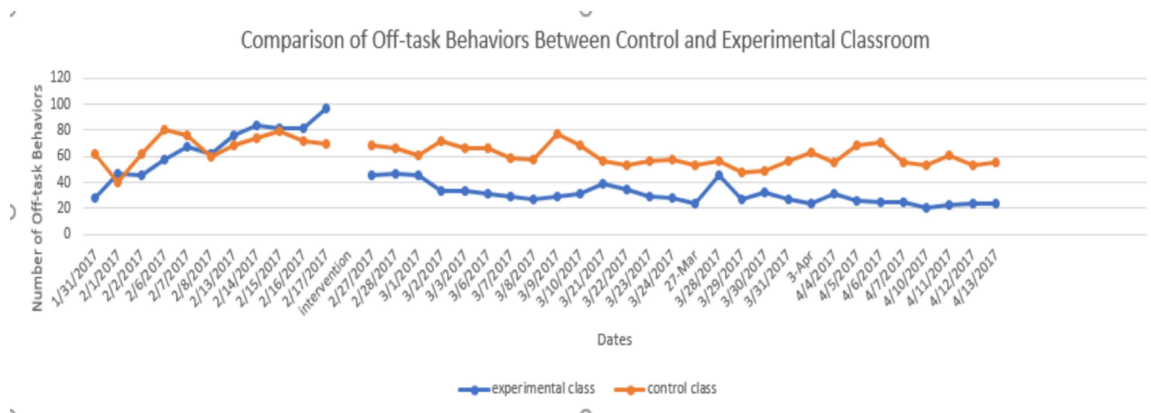


Figure 2. Comparison of Off-task Behaviors Between Control and Experimental Classroom.

During baseline, the mean for the control group was 65.94 with a standard deviation of 12.24 and the mean for the experimental group was 67.45 with a standard deviation of 8.89. During the intervention, the mean for the control group was 60.05 with a standard deviation of 2.90 and the mean for the experimental group was 31.17 with a standard deviation of 5.04. Expending Box's test of equality of covariance matrices to assess the homogeneity of the covariance across groups using  $p < .001$  as a criterion, the Box M score of 6.31 was not significant as  $p (.130) > a (.001)$ . Table 4 indicates there are no significant differences.

Table 4. *Differences between the covariance matrices.*

<b>Box's Test of Equality of Covariance Matrices<sup>a</sup></b>	
Box's M	6.314
F	1.882
df1	3
df2	6491.270
Sig.	.130

The following test measures whether there was an effect over time and whether it was significant. It does not report which group, but rather that there was a change over time. There was a significant change in off task behavior over time ( $F(24,1) = 150.29$ ,  $p < .001$ ,  $\eta^2 = .862$ ). The second test measures whether there was an interaction between groups and time. There was a significant difference found between time and group ( $F(24,1) = 78.04$ ,  $p < .001$ ,  $\eta^2 = .765$ ). Table 5 is the Tests of Within-Subjects Effects.

Table 5. *Tests of Within-Subjects Effects.*

<b>Tests of Within-Subjects Effects</b>					
Measure: MEASURE_1					
Source		Type III Sum of Squares	Df	Mean Square	F
factor1	Sphericity	5232.413	1	5232.413	150.29
	Assumed				0
	Greenhouse- Geisser	5232.413	1.000	5232.413	150.29
	Huynh-Feldt	5232.413	1.000	5232.413	150.29
	Lower-bound	5232.413	1.000	5232.413	150.29
factor1 * Group	Sphericity	2717.133	1	2717.133	78.044
	Assumed				
	Greenhouse- Geisser	2717.133	1.000	2717.133	78.044
	Huynh-Feldt	2717.133	1.000	2717.133	78.044
	Lower-bound	2717.133	1.000	2717.133	78.044
Error(factor 1)	Sphericity	835.568	24	34.815	
	Assumed				
	Greenhouse- Geisser	835.568	24.000	34.815	
	Huynh-Feldt	835.568	24.000	34.815	
	Lower-bound	835.568	24.000	34.815	

Likewise, the tests of between-subjects' effects found a statistically significant difference between the control and intervention groups for reading scores. Using Cohen's (1988) effect size samples for Partial Eta Squared .426 would be a very large effect size.

Table 6 is the Tests of Between-Subjects Effects.

Table 6. *Tests of Between-Subjects Effects.*

Tests of Between-Subjects Effects						
Measure: MEASURE_1						
Transformed Variable: Average						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	148432.362	1	148432.362	1695.529	.000	.986
Group	2206.161	1	2206.161	25.201	.000	.512
Error	2101.042	24	87.543			

The control group is measured in blue in the graph below and the experimental group is measured in green. Figure 3 displays the difference between the control and experimental group.

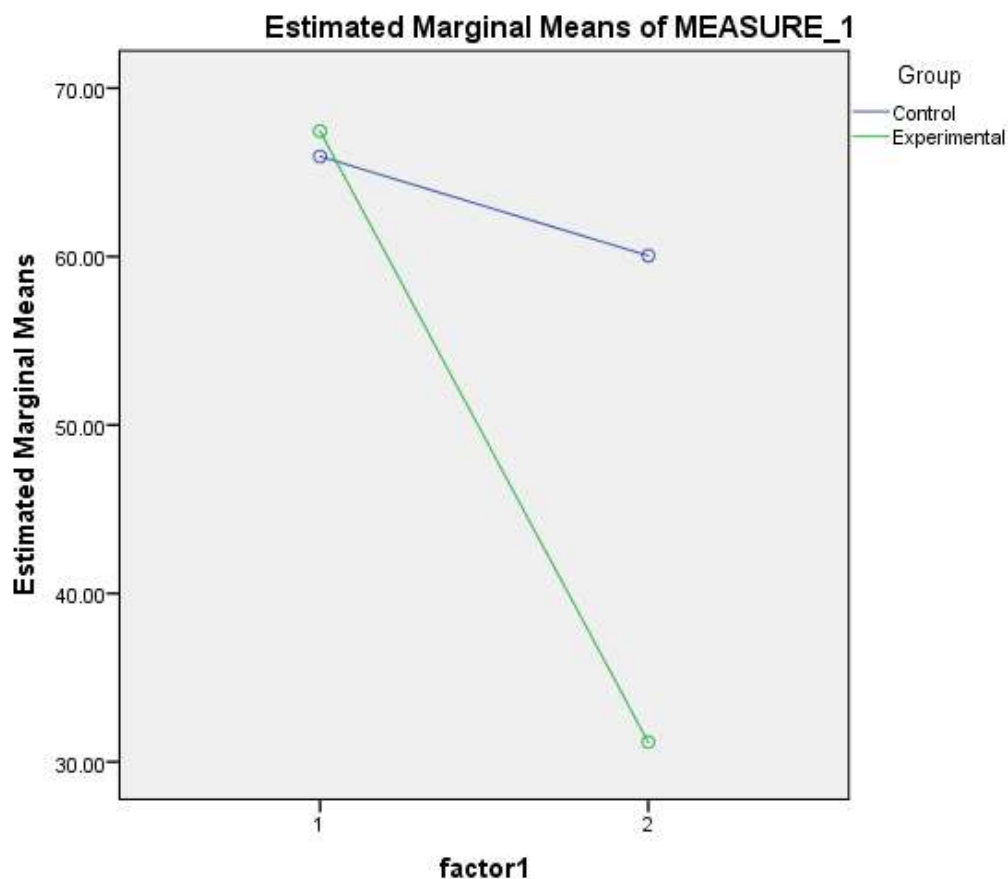


Figure 3. Estimated Marginal Means for Off-Task Behavior.

The T-Test confirms there were no differences between groups at baseline using the Levene test for equality of variances in an independent samples test ( $t(24) = -.36, p = .722$ ). Table 7 displays significant differences between groups in the intervention phase ( $t(24) = 15.77, p < .001$ ).

Table 7. *Independent Samples Test.*

		<b>Independent Samples Test</b>								
		Levene's Test for Equality of Variances			t-test for Equality of Means					
								95% Confidence Interval of the Difference		
		F	Sig.	t	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Baseline	Equal variances assumed	2.453	.130	-.360	24	.722	-1.50303	4.17582	- 10.12151	7.11545
	Equal variances not assumed			-.326	12.597	.750	-1.50303	4.61502	- 11.50573	8.49967
Intervention	Equal variances assumed	.909	.350	15.769	24	.000	28.88562	1.83180	25.10497	32.66627
	Equal variances not assumed			18.539	23.726	.000	28.88562	1.55809	25.66791	32.10333

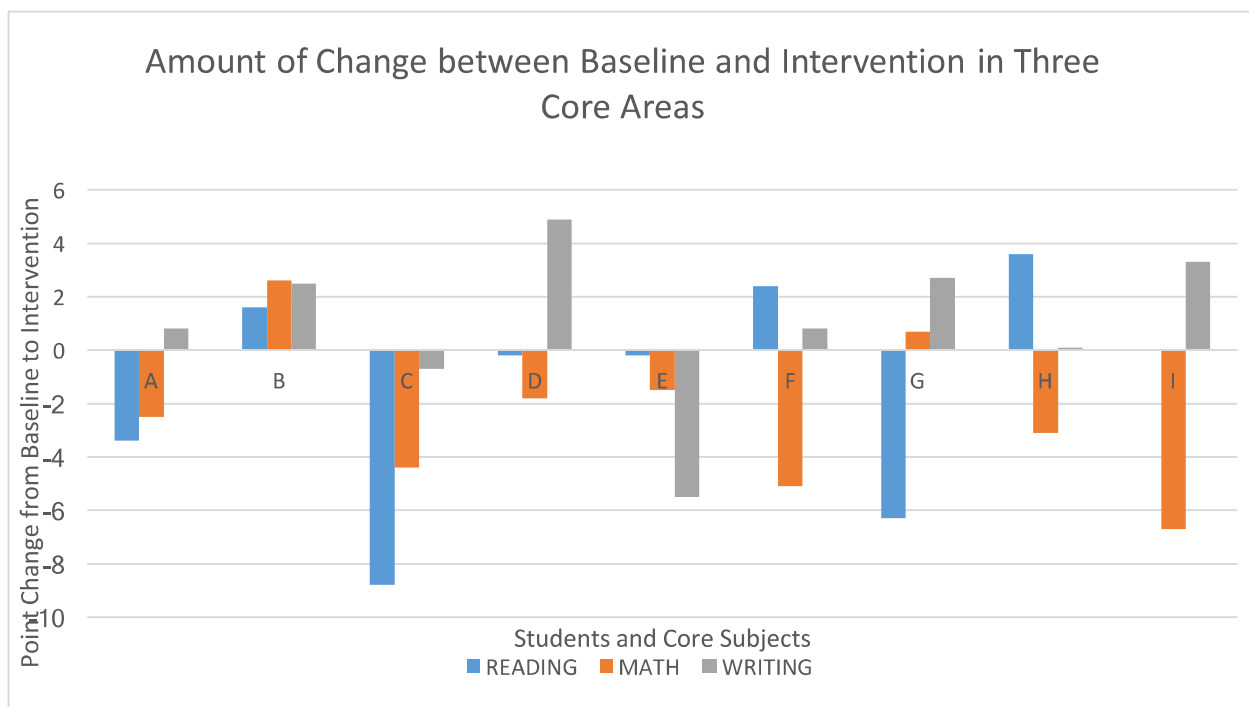
**Academic achievement.** Reading, math, and writing grades were recorded for in the control and experimental classes during baseline data collection and intervention data collection. The school district where the study took place has very strict guidelines and rubrics for grading; therefore, consistency and fidelity are high in grading the three core subjects (a) reading, (b) math, and (c) writing. Grades are averaged in the district computer to one decimal place as new grades are entered each day. The following scores represent grades in the three core subjects at the end of baseline data collection, February 17, 2017 and the end of intervention data collection, April 13, 2017.

*Control classroom grades.* The control classroom consisted of nine students. The grades for baseline and intervention were recorded daily and averaged by the district computing system. The following are the results for the control classroom for three core subjects (a) reading, (b) math, and (c) writing. Table 8 shows the comparison of Baseline and Intervention Grades for Control Classroom.

Table 8. *Comparison of Baseline and Intervention Grades for Control Classroom.*

	Baseline Reading Average	Intervention Reading Average	Baseline Math Average	Intervention Math Average	Baseline Writing Average	Intervention Writing Average
Student A	97.8	94.4	96.6	94.1	99.2	100.0
Student B	92.8	94.4	91.9	94.5	97.5	100.0
Student C	94.2	85.4	91.2	86.8	97.5	96.8
Student D	93.5	93.3	93.2	91.4	95.1	100.0
Student E	95.7	95.5	90.1	88.6	99.2	93.7
Student F	92.0	94.4	96.6	91.5	99.2	100.0
Student G	90.6	84.3	86.7	87.4	92.6	95.3
Student H	96.4	100.0	99.7	96.6	99.2	100.0
Student I	86.5	86.5	95.0	88.3	92.0	95.3

In the control classroom, reading scores decreased for four out of 9 students between baseline and intervention phases. The average change for reading was a 1.26 decrease. During the same time frame the math scores decreased 2.42 points between baseline data collection and intervention data collection. Seven out nine students had a decrease in math scores during this period. Writing scores for the control classroom displayed a 0.99 increase from baseline data collection. Only two students in the control classroom had a decrease in scores in writing during this period. Overall, there was a 2.69 increase in scores across the nine students in the control classroom between baseline data collection and intervention data collection in writing scores. Figure 4 shows the Amount of Change between Baseline and Intervention in Three Core Areas.



*Figure 4.* Amount of Change between Baseline and Intervention in Three Core Areas. Note. The core subjects were relevant to this study because it shows the number of increases and decreases before the intervention and after the intervention.

The mean for the control group during baseline for reading was 93.28 with a standard deviation of 3.39 and the mean for the experimental group during baseline for reading was 93.78 with a standard deviation of 4.58. During intervention, the mean for the control group was 92.02 with a standard deviation of 5.34 and the mean for the experimental group during intervention was 99.70 with a standard deviation of .77. Using Box's Test of Equality of Covariance of Matrices to assess the homogeneity of the covariance across groups using  $p < .001$  as a criterion, the Box M score of 45.95 was significant as  $p = .000$ . Table 9 is the Box's Test of Equality of Covariance of Matrices.

Table 9. *Box's Test of Equality of Covariance of Matrices.*

<b>Box's Test of Equality of Covariance Matrices<sup>a</sup></b>	
Box's M	45.947
F	13.695
df1	3
df2	6491.270
Sig.	.000

The following test measures whether there was an effect over time and whether it was significant for reading. It does not report which group, but rather that there was a change over time. There was a significant change in reading scores for academic achievement ( $F(24,1) = 7.53, p < .001, \eta^2 = .239$ ). The second test measures whether there was an interaction between groups and time for reading. There was a significant difference found between time and group ( $F = 24,1 = 17.81, p < .001, \eta^2 = .239$ ). Table 10 shows the tests of within-subjects effects.

Table 10. *Tests of within-subjects' effects.*

Source		Type III Sum of Squares	df	Mean Square	F
factor1	Sphericity Assumed	64.113	1	64.113	7.528
	Greenhouse-Geisser	64.113	1.000	64.113	7.528
	Huynh-Feldt	64.113	1.000	64.113	7.528
	Lower-bound	64.113	1.000	64.113	7.528
factor1 * Group	Sphericity Assumed	151.644	1	151.644	17.807
	Greenhouse-Geisser	151.644	1.000	151.644	17.807
	Huynh-Feldt	151.644	1.000	151.644	17.807
	Lower-bound	151.644	1.000	151.644	17.807
Error(factor1)	Sphericity Assumed	204.386	24	8.516	
	Greenhouse-Geisser	204.386	24.000	8.516	
	Huynh-Feldt	204.386	24.000	8.516	
	Lower-bound	204.386	24.000	8.516	

Likewise, the tests of between-subject's effects found a statistically significant difference between the control and intervention groups for reading scores. Using Cohen's (1988, pp 284-287) effect size samples for Partial Eta Squared .426 would be a very large effect size. Table 11 displays the tests of between-subjects' effects.

Table 11. *Tests of Between-Subjects Effects.*

<b>Tests of Between-Subjects Effects</b>			
Measure: MEASURE_1			
Source		Sig.	Partial Eta Squared
factor1	Sphericity Assumed	.011	.239
	Greenhouse-Geisser	.011	.239
	Huynh-Feldt	.011	.239
	Lower-bound	.011	.239
factor1 * Group	Sphericity Assumed	.000	.426
	Greenhouse-Geisser	.000	.426
	Huynh-Feldt	.000	.426
	Lower-bound	.000	.426
Error(factor1)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		

#### Estimated Marginal Means of Measure 1

The control group is measured in blue in the graph below and the experimental group is measured in green. Figure 5 displays the difference between the control and experimental group in reading grades.

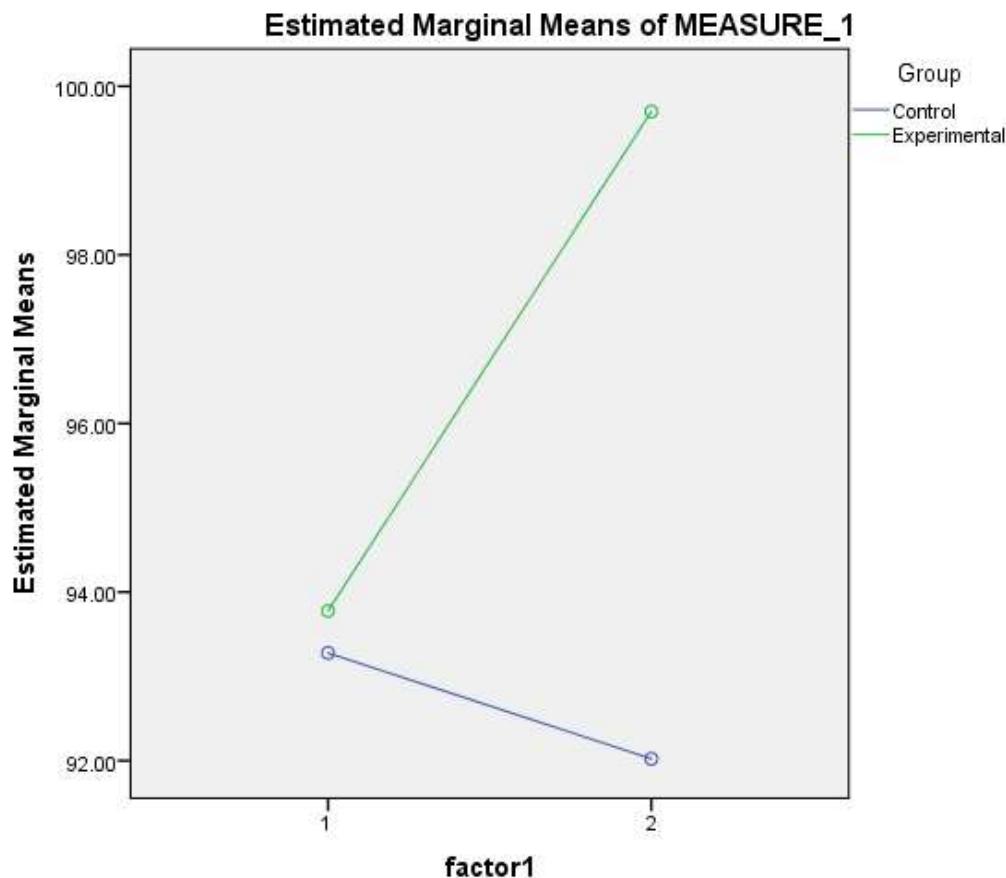


Figure 5. Estimated Marginal Means of Measure in Reading.

**Math scores.** The mean for the control group during baseline in math was 93.44 with a standard deviation of 3.96. The mean for the experimental group during baseline in math was 96.01 with a standard deviation of 4.01. The mean for the control group during intervention was 91.02 with a standard deviation of 3.49. The mean for the experimental group during intervention was 101.00 with a standard deviation of 3.30. Using Box's Test of Equality of Covariance of Matrices to assess the homogeneity of the covariance across groups using  $p < .001$  as a criterion, the Box M score of 1.15 was significant as  $p = .795$ . Table 12 shows the box's test of equality of covariance of matrices for math.

Table 12. *Box's Test of Equality of Covariance Matrices for Math.*

<b>Box's Test of Equality of Covariance Matrices<sup>a</sup></b>	
Box's M	1.147
F	.342
df1	3
df2	6491.270
Sig.	.795

The following test measures whether there was an effect over time and whether it was significant for math. It does not report which group, but rather that there was a change over time. There was a significant change in math scores for academic achievement ( $F(24,1) = 2.94, p < .001, \eta^2 = .109$ ). The second test measures whether there was an interaction between groups and time for math. There was a significant difference found between time and group ( $F = 24,1 = 24.56, p < .001, \eta^2 = .506$ ). Using Cohen's (1988, pp 284-287) effect size samples for Partial Eta Squared .506 would be a very large effect size. Table 13 displays whether there was an effect over time and whether it was significant in math. Table 14 measures whether there was an interaction between groups and time for math.

Table 13. *Results for effect over time and whether it was significant in math.*

	Source	Type III Sum of Squares	Df	Mean Square	F
	Sphericity Assumed	19.373	1	19.373	2.944
factor1	Greenhouse-Geisser	19.373	1.000	19.373	2.944
	Huynh-Feldt	19.373	1.000	19.373	2.944
	Lower-bound	19.373	1.000	19.373	2.944
	Sphericity Assumed	161.576	1	161.576	24.555
factor1 * Group	Greenhouse-Geisser	161.576	1.000	161.576	24.555
	Huynh-Feldt	161.576	1.000	161.576	24.555
	Lower-bound	161.576	1.000	161.576	24.555
	Sphericity Assumed	157.927	24	6.580	
Error(factor1)	Greenhouse-Geisser	157.927	24.000	6.580	
	Huynh-Feldt	157.927	24.000	6.580	
	Lower-bound	157.927	24.000	6.580	

Table 14. *Interaction between Groups and Time for Math.*

<b>Tests of Within-Subjects Effects</b>			
Measure: MEASURE_1			
Source		Sig.	Partial Eta Squared
factor1	Sphericity Assumed	.099	.109
	Greenhouse-Geisser	.099	.109
	Huynh-Feldt	.099	.109
	Lower-bound	.099	.109
factor1 * Group	Sphericity Assumed	.000	.506
	Greenhouse-Geisser	.000	.506
	Huynh-Feldt	.000	.506
	Lower-bound	.000	.506
Error(factor1)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
Estimated Marginal Means of Measure 1			

Figure 6 shows the control group and experimental group's marginal means in math. The control group is measured in blue and the experimental group is measured in green on the graph.

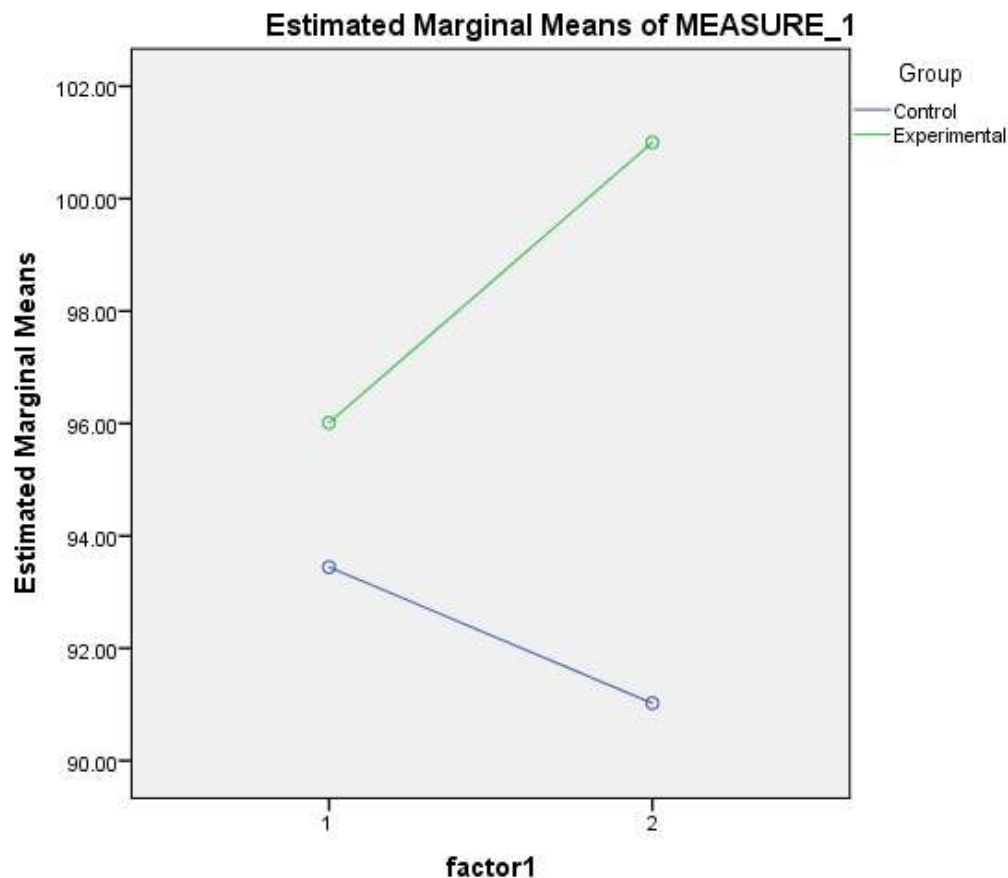


Figure 6. *The Control Group and Experimental Group's Marginal Means in Math.*

**Writing scores.** The mean for baseline in the control group was 96.83 with a standard deviation of 2.91 in writing. The mean for baseline in the experimental group was 95.38 with a standard deviation of 4.04. The mean for intervention in the control group was 97.9 with a standard deviation of 2.61 and the mean for intervention in the experimental group was 99.46 with a standard deviation of .93 in writing. Using Box's Test of Equality of Covariance of Matrices to assess the homogeneity of the covariance across groups using  $p < .001$  as a criterion, the Box M score of 17.95 was moderate as  $p = .001$ . Table 15 is the box's test of equality of covariance of matrices.

Table 15. *Box's Test of Equality of Covariance Matrices.*

<b>Box's Test of Equality of Covariance Matrices<sup>a</sup></b>	
Box's M	17.945
F	5.349
df1	3
df2	6491.270
Sig.	.001

The following test measures whether there was an effect over time and whether it was significant for writing. It does not report which group, but rather that there was a change over time. There was a significant change in writing scores for academic achievement ( $F(24,1) = 13.81, p < .001, \eta^2 = .365$ ). The second test measures whether there was an interaction between groups and time for writing. There was a significant difference found between time and group ( $F = 24,1 = 4.74, p < .001, \eta^2 = .165$ ). Using Cohen's (1988, pp 284-287) effect size samples for Partial Eta Squared .165 would be a large effect size. Table 16 displays the change over time and the effect in writing grades. Table 17 measures if there is an interaction between the control and experimental group for reading.

Table 16. *Interactions between the Control and Experimental Group in Reading.*

Source		Type III Sum of Squares	Df	Mean Square	F
factor1	Sphericity Assumed	78.008	1	78.008	13.806
	Greenhouse-Geisser	78.008	1.000	78.008	13.806
	Huynh-Feldt	78.008	1.000	78.008	13.806
	Lower-bound	78.008	1.000	78.008	13.806
factor1 * Group	Sphericity Assumed	26.758	1	26.758	4.736
	Greenhouse-Geisser	26.758	1.000	26.758	4.736
	Huynh-Feldt	26.758	1.000	26.758	4.736
	Lower-bound	26.758	1.000	26.758	4.736
Error(factor1)	Sphericity Assumed	135.602	24	5.650	
	Greenhouse-Geisser	135.602	24.000	5.650	
	Huynh-Feldt	135.602	24.000	5.650	
	Lower-bound	135.602	24.000	5.650	

Table 17. *Measurement if there is an Interaction between the Control and Experimental Group for Reading.*

<b>Tests of Within-Subjects Effects</b>			
Measure: MEASURE_1			
Source		Sig.	Partial Eta Squared
factor1	Sphericity Assumed	.001	.365
	Greenhouse-Geisser	.001	.365
	Huynh-Feldt	.001	.365
	Lower-bound	.001	.365
factor1 * Group	Sphericity Assumed	.040	.165
	Greenhouse-Geisser	.040	.165
	Huynh-Feldt	.040	.165
	Lower-bound	.040	.165
Error(factor1)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		

Figure 7 shows the control group and experimental group's marginal means in writing. The control group is measured in blue in the graph below and the experimental group is measured in green.

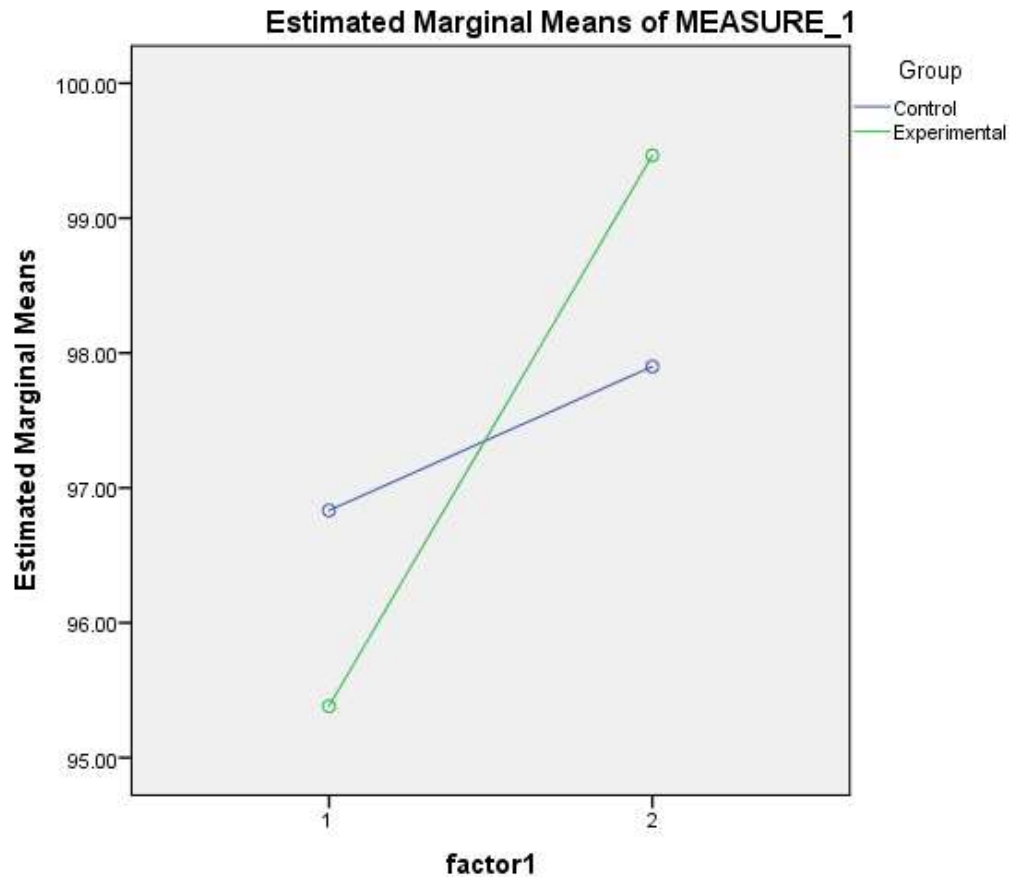


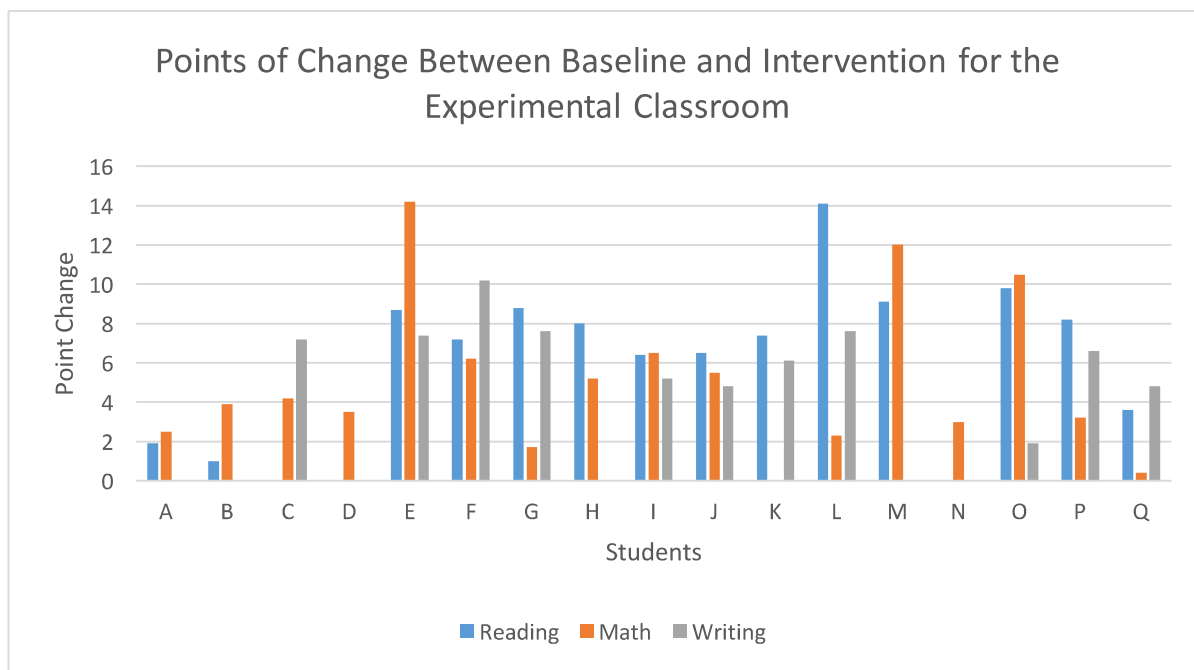
Figure 7. Estimated Marginal Means in Writing.

**Experimental classroom.** Data were also recorded at the end of baseline and end of intervention for the experimental classroom in three core subjects (a) reading, (b) math, and (c) writing. The baseline study ended on February 17, 2017 and the intervention study ended on April 13, 2017. These two scores were compared for gains from baseline to intervention. The following chart depicts those grades as recorded for all 17 students. Table 18 shows the comparison of grades for the experimental classroom.

Table 18. *Comparison of Baseline and Intervention Grades for the Experimental Classroom*

	Baseline Reading Average	Intervention Reading Average	Baseline Math Average	Intervention Math Average	Baseline Writing Average	Intervention Writing Average
Student AA	98.1	100.0	100.5	103.0	100.0	100.00
Student BB	99.0	100.0	99.7	103.6	100.0	100.0
Student CC	100.0	100.0	99.2	103.4	92.8	100.0
Student DD	100.0	100.0	100.5	104.0	100.0	100.0
Student EE	91.3	100.0	89.8	104.0	92.6	100.0
Student FF	92.8	100.0	91.5	97.7	89.8	100.0
Student GG	90.4	99.2	93.4	95.1	89.8	97.4
Student HH	92.0	100.0	93.7	98.9	100.0	100.0
Student II	93.6	100.0	97.5	104.0	94.8	100.0
Student JJ	92.1	98.6	92.9	98.4	93.9	98.7
Student KK	92.6	100.0	100.0	100.0	93.9	100.0
Student LL	83.0	97.1	91.6	93.9	89.8	97.4
Student MM	90.9	100.0	90.7	102.7	100.00	100.0
Student NN	100.0	100.0	100.0	103.0	100.0	100.0
Student OC	90.2	100.0	92.9	103.4	98.1	100.0
Student PP	91.8	100.0	100.0	103.2	92.1	98.7
Student QQ	96.4	100.0	98.3	98.7	93.9	98.7

Every student in the experimental classroom had the same grade as the baseline phase for the intervention phase or their score increased. Three students stayed the same in reading scores between baseline and intervention in the experimental classroom. The other 14 students had increased scores. There was a 5.92 average increase from baseline to intervention for reading scores in the experimental classroom. Only one student in the experimental class had the same score in the intervention phase that they had received in baseline. The other 16 students had an increased score from baseline. The average point change was 4.99. Six students' scores remained the same in intervention as in baseline. The other 11 student scores increased for writing in the experimental classroom from baseline to intervention. The average increase was 4.08 for writing scores between baseline and intervention in the experimental classroom. Figure 8 displays Points of Change Between Baseline and Intervention for the Experimental Classroom.



*Figure 8.* Points of Change Between Baseline and Intervention for the Experimental Classroom.

## **Evaluation of the Findings**

This study set out to answer two research questions (a) what difference, if any, exists in off task behavior between fourth grade students who are seated on a dynamic air-filled disk versus a static hard plastic chair and (b) what difference, if any, exists in academic achievement between fourth grade students who are seated on a dynamic air-filled disk versus a static hard plastic chair. Previous research suggested positive outcomes were possible. The hypotheses expected one of two outcomes for each question (a) there will be no significant difference in off-task behavior or academic achievement of fourth grade students seated on air-filled disks after previously being seated on hard plastic chairs versus students who continue to be seated on hard plastic chairs or (b) there will be a significant difference in off-task behavior or academic achievement between fourth grade students seated on air-filled disks after previously being seated on hard plastic chairs versus students who continue to be seated on hard plastic chairs.

*What differences, if any, exists in off-task behavior between fourth grade students who are seated on a dynamic air-filled disk versus a static hard plastic chair.*

Research indicated students spend approximately five leisure hours per day in sedentary screen time rather than engaging in physical activity (Smedegaard et al., 2016). With the lack of movement built into the seven-hour school day, students are moving less and less (Jaggi, Bakhshi, & Sandhu, 2013) and the combination of these two activities has led to a reported increase in attentional problems and academic and behavioral difficulties (American Academy of Pediatrics, 2016). Previous researchers discovered increased on-task behaviors with the addition of dynamic seating (Seifert & Metz, 2017; Burgoyne & Ketcham, 2015; Schaaf et al., 2015; Wans-Yunis et al., 2015; Goodmon et al., 2014;

Fedewa & Erwin, 2011; Pfeiffer et al., 2008). The researchers found dynamic seating to be effective with neurotypical students as well as those with ADHD, specific learning disabilities, and sensory processing disorder. In a typical classroom, there are students in each of these categories. This was true for the fourth-grade classrooms used in this research as well.

As expected based on previous research, there was a significant difference in off-task behavior for fourth grade students who were seated on air-filled disks compared to like peers who were seated in rigid plastic chairs. Off-task behavior decreased by 53.85% in the experimental class with the addition of the air-filled disks to the static chairs during the intervention phase. The control classroom had a 7.85% decrease from baseline for the same period. The experimental class did 46% better at being on-task during the intervention phase of the experiment. When asked to list what they liked best about fourth grade, the students in the experimental classroom frequently wrote the air-filled cushions as one of their top favorite things about the school term.

Several researchers had implemented physical exercise as a way of providing proprioceptive input through planned activities and extra recess activities (Rhea, 2016; Khaledi et al., 2014). While these activities produced increased on-task behaviors in the classroom, two factors cause this course of action to be less desirable. First, most educators have little control over the amount of recess time allowed for a classroom as this is mandated by the school district. Second, more recess and structured physical activities take away from teaching time. Since every minute in the teacher's day is prescribed by the district, it would be difficult to attempt this research unless it were a

whole district initiative. Providing the air-filled disks allowed the teacher to keep teaching but provide the needed side to side movement for the students.

***What difference, if any, exists in academic achievement between fourth grade students who are seated on a dynamic air-filled disk versus a static hard plastic chair.***

There were no researchers who specifically reported academic achievement rates in reading, math, and writing; however, several gave generalized reports of academic improvement. Ratey and Loehr (2011) found students performed better on the third step of the Stroop Test after completing physical activity. This particular subtest asks participants to read the color word which is written in an alternative color. This is a difficult portion of the test and requires higher executive function skills.

The Goodman et al. (2014) research reported improved behavior, attention, and motivation when seated on dynamic disks for students with dyslexia. This research reported a general increase in academic achievement with the exception of reading comprehension. Since some students with dyslexia have a scotopic sensitivity, perhaps the balancing of the stability ball paired with their lack of motor coordination skills impaired the eye's ability to track during extended reading. Possibly the air-filled disks which do not require balancing in the same way the ball does would be of benefit to those students with scotopic sensitivity. No researchers were found to specifically relate mathematics or writing scores.

In this research project, there was a moderate difference in academic achievement between the control classroom and the experimental classroom. Overall, the control classroom experienced a 2.69 decrease in academic scores from baseline to intervention. Overall the experimental classroom underwent a 14.99-point increase in academic scores

from baseline to intervention. Data point to an overall improvement in academic scores as the experimental classroom scored 12.30 points higher than the control classroom. Divided by participants, the control classroom averaged a 0.29 decrease from baseline grades to intervention grades. In the experimental classroom, the average student increased 0.88 points from baseline grades to intervention grades. This would be an average difference of .59 per student.

Specifically, reading improved by 5.92 percentage points from 93.78 to 99.70 on average during the six weeks of intervention. Math improved from 96.01 to 101.00 for a 4.99 increase in percentage points. Writing improved 4.08 percentage points from 95.38 to 99.46 on average during the six weeks of intervention. This research can be added to the growing research on movement needs for students in the classroom. The current research did not report any correlational studies between dynamic seating and academic scores. This study provides baseline data for further studies regarding the degree to which dynamic seating can improve academic scores in reading, math, and writing.

### **Summary**

Most students in the United States are seated on hard plastic or hard wood chairs in the classroom for seven hours or more per day (Jaggi et al., 2013). While the idea of alternative seating is catching on in many schools, few are conducting research to determine the effectiveness of the various seating elements available (Ramli et al., 2013). Air-filled disks were chosen in this study for the following reasons (a) inexpensive price, (b) ability to secure to chair, and (c) ability to adjust air level and texture for individual student's needs. Many of the other seating choices are much more expensive and not as adjustable per student need. Many schools have tried the exercise balls which roll away

when the students move about the classroom and are difficult to store at the end of the day (Ramli et al., 2013). The air-filled disk alleviated many of those issues. The air-filled disk provided enough proprioceptive input to allow the students to move within their seat and this alleviated out of seat behavior, decreased blurting, and decreased fidgeting in inappropriate ways. By curbing these behaviors, it allowed all students to be more on task and less disruptive to the class; as evidenced by the decreased off task behavior in the experimental classroom during the intervention phase.

## Chapter 5: Implications, Recommendations, and Conclusions

Given the continued emphasis on classroom management strategies in professional development courses, it is important to examine new methods, materials, and strategies that can improve on task behavior for students (Oliver et al., 2011). This study provides evidence for the potential benefit of using an air-filled disk to promote such outcomes. The findings from the use of air-filled disks on static chairs in a fourth-grade classroom in a Midwest suburban school examine the effectiveness of decreasing off task behaviors. Off task behaviors were decreased therefore on task behaviors were increased. This chapter provides a discussion of (a) implications, (b) recommendations for practice, (c) recommendations for future research, and (d) conclusions.

### Implications

The primary purpose of this study was to determine if the addition of dynamic seating to standard static chairs would provide enough proprioceptive input to increase on task behavior which would decrease off task behavior and improve academic achievement. Findings are discussed for the following areas (a) off-task behaviors and (b) academic achievement.

**Off task behaviors.** Instructors did not alter their teaching methods in any way during the implementation of this intervention. Students were still taught using the exact methods prescribed by the district for all subjects. There were two possible variables. One was under the control of the experiment and the other was not. The first condition over which the researcher had control was the addition of air-filled disks to the static chairs. While most off-task behaviors are not disruptive to the class, they are cumulative for each individual student. Fidgeting inappropriately and being up out of the seat without

permission are two conditions that could impact learning for the individual. Blurting out of turn can be disruptive to the entire class or to those near the blurter. The latter behavior occurred the least in the experimental and control classrooms; however, all off task behaviors were desired behaviors to target for change.

**Control classroom.** The cumulative effect for off task behaviors during baseline in the control classroom averaged 586 off task behaviors per day. This equates to 65.11 per student. There was a slight incline in off task behaviors during the week of the highly-anticipated Valentine’s Day Party. This party is the last party of the year and is advertised by the room mothers as an exciting event. Fourth graders are excited by parties. Figure 9 displays the total off task behaviors during baseline for the control classroom.

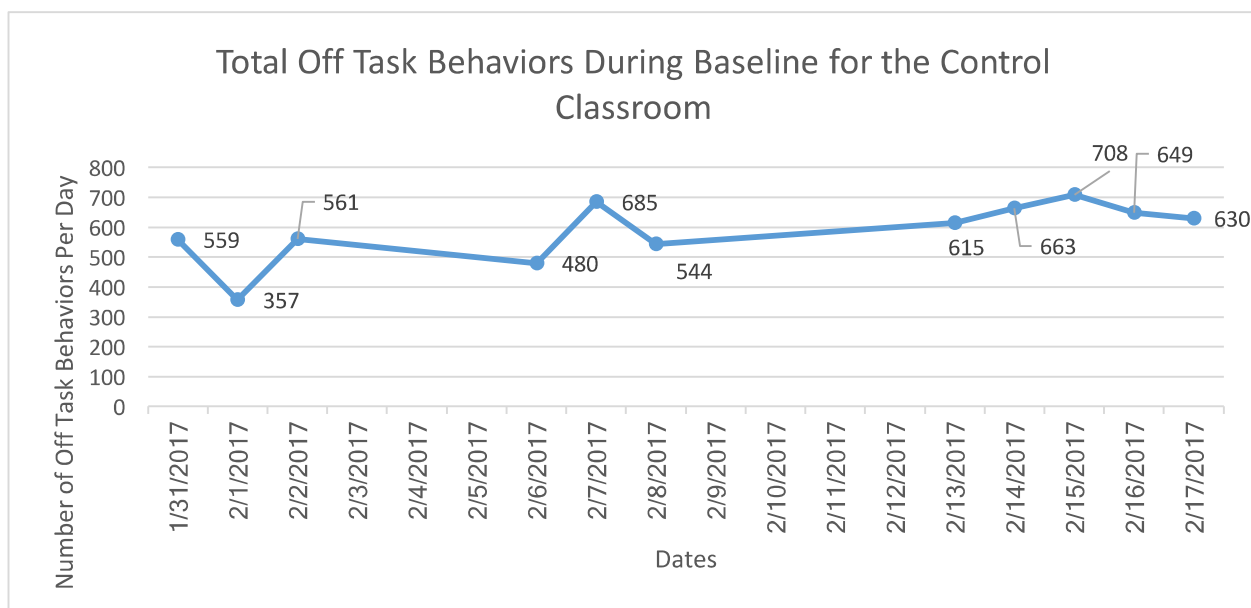


Figure 9. Total off task behaviors during baseline for the control classroom.

The cumulative effect for off task behaviors in the control class during the intervention phase was 540 behaviors per day. This equates to 60 behaviors per day. This is a 7.85% decrease from baseline. This decrease may be attributed to maturity levels or the increased baseline may be attributed to the anticipation of the party. It is not a significant decrease from baseline. Figure 10 shows the total for off task behaviors during intervention for the control classroom.

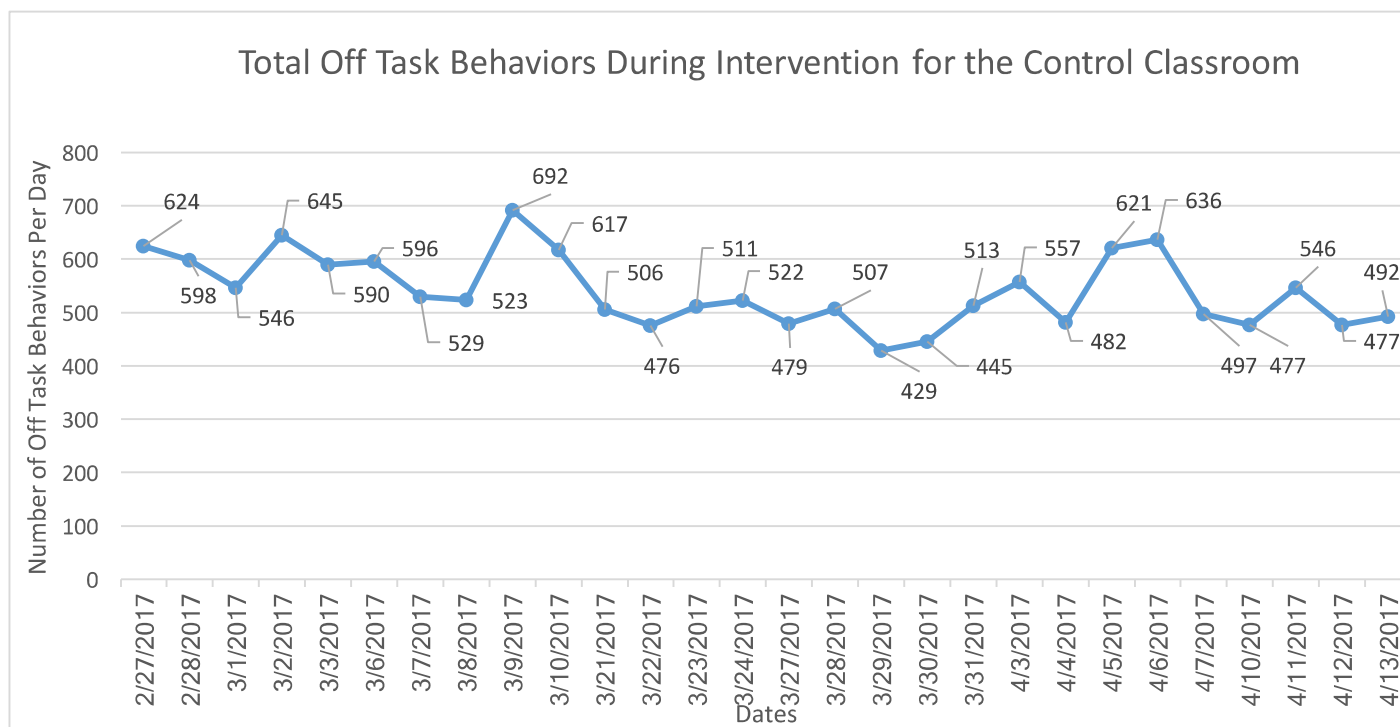
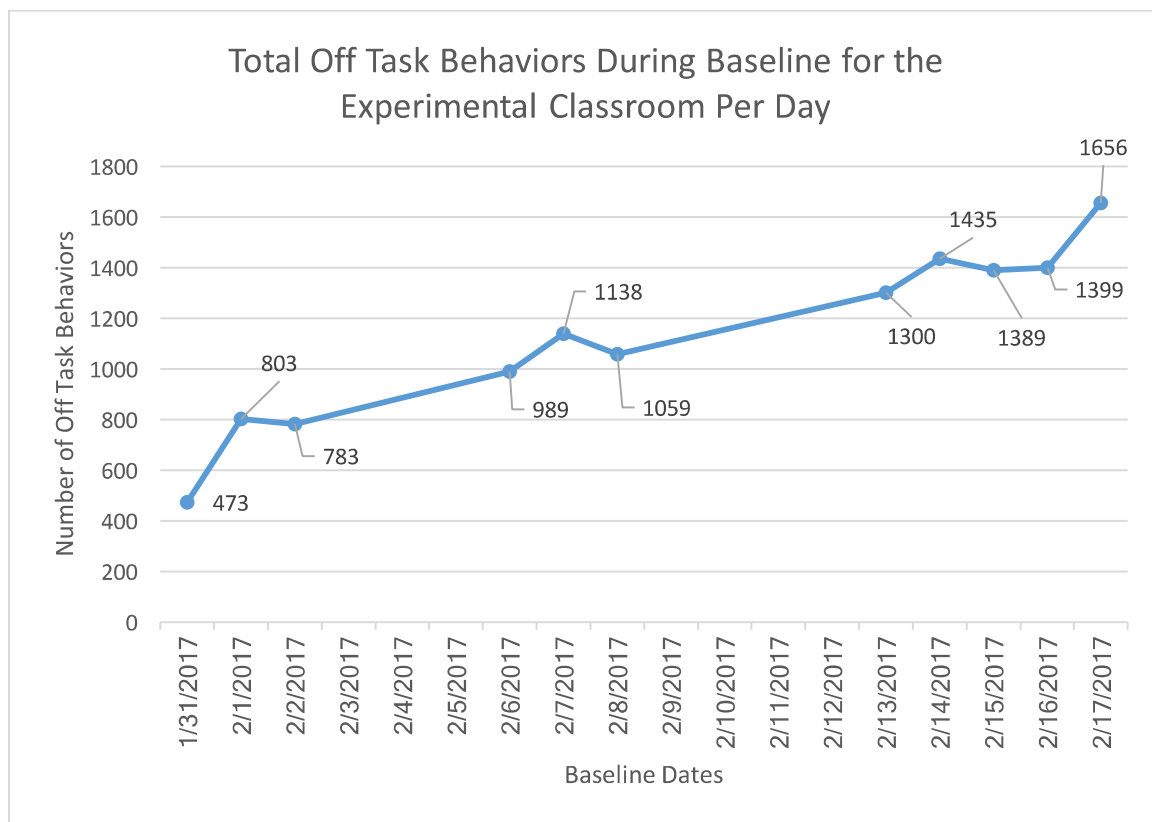


Figure 10. Total off task behaviors during intervention for the control classroom.

**Experimental classroom.** The cumulative effect for off task behaviors averaged 1,129 off task behaviors per day. This equates to 66.41 per student. The Valentine's Day Party being the last party of the year is a highly-anticipated party for fourth grade students and the room mothers talk excitedly about the upcoming party to the students. The last week of baseline was a significant increase over the first two weeks of baseline which pushed the daily average. In the future, research should consider avoiding

classroom parties and upcoming school breaks. This could not be avoided for this study.

Figure 11 displays the total off task behaviors during baseline for the experimental classroom per day.



*Figure 11.* Total Off Task Behaviors During Baseline for the Experimental Classroom Per Day.

Once the cushions were added to the chairs and one week was given for adjustment, data were again collected for off task behaviors. The average cumulative off task behaviors per day during intervention was 521 per day. This equates to 30.65 per student per day. This included spring break and returning from spring break after being off for a week. This is a decrease of 608 off task behaviors per day. Fourth graders are fidgety by nature. This intervention decreased those off-task fidgets and kept the students more engaged in on task behaviors. This is a cumulative decrease of 53.85% for off task behaviors with the addition of air-filled disks. Figure 12 displays the total off task behaviors during intervention for the experimental classroom per day.

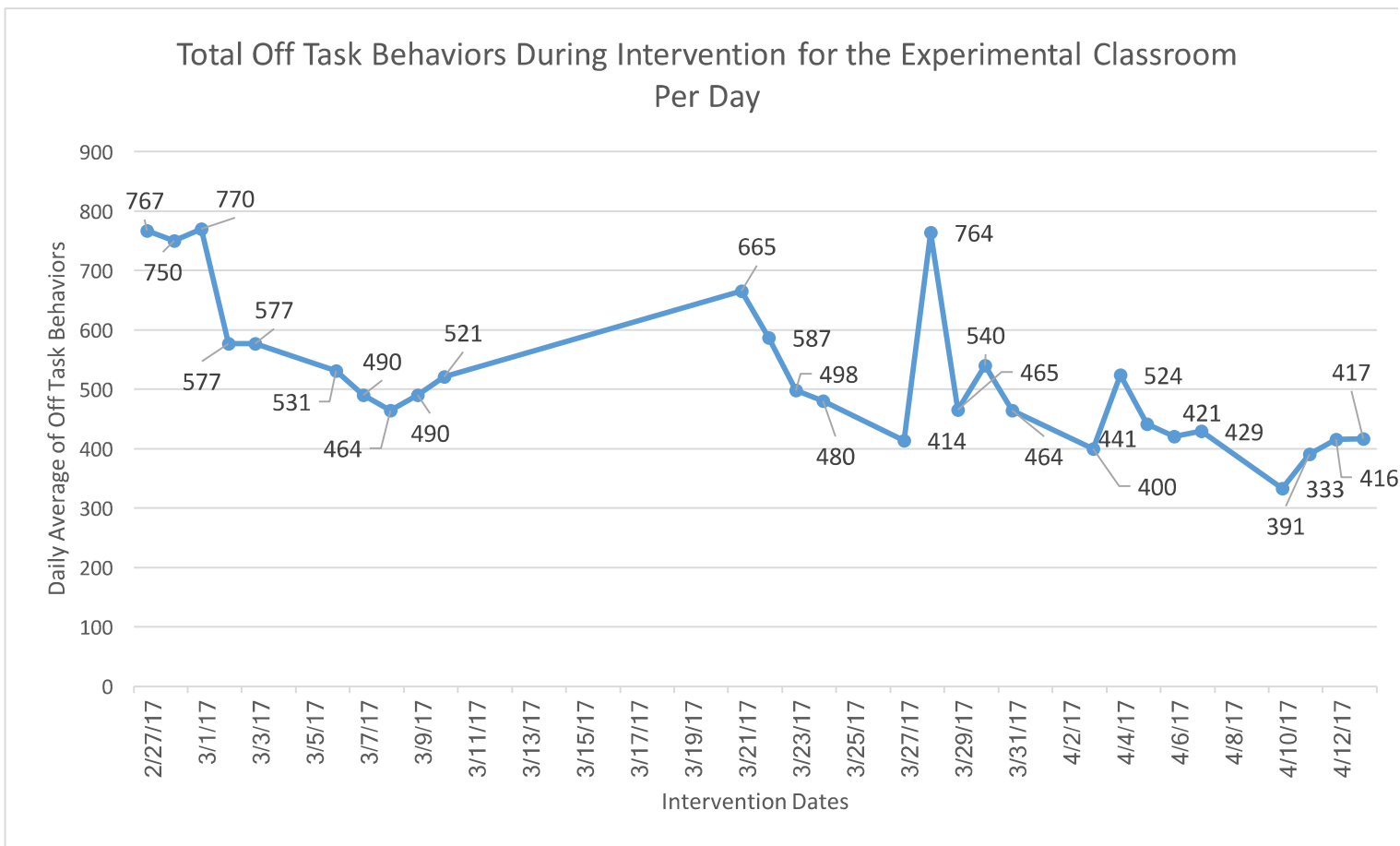


Figure 12. Total Off Task Behaviors During Intervention for the Experimental Classroom Per Day.

By using a videotape method for data recording, this researcher could distinguish inappropriate fidgets, out of seat behaviors, and small blurts that might be missed when engaged with a skill group or one on one help with a student. If the researcher had relied on only witnessed behaviors while teaching, many off task behaviors would have gone unnoticed.

**Summary of off task behaviors.** The average daily behavior per student in the control and experimental classrooms were 65.11 and 66.41 respectively. Post the introduction of the air-filled disks into the experimental classroom the average daily behavior per student in the control and experimental classrooms were 60 and 30.65 respectively. This is a difference of 29.35 off task behaviors per student per day. Cumulatively it can be assumed this would apply to most students and in a typical class of 23 students this would equate to approximately 675 less off task behaviors per day. Many off task behaviors go unnoticed during the day as teachers are busy with small skill groups or assisting individual students. The videotape recording provided the most accurate account for off task behaviors.

The first research question was to determine the difference, if any, existed in off-task behavior between fourth grade students who are seated on a dynamic air-filled disk versus a static rigid plastic chair. Statistically, there was a significant difference in off task behaviors with a .426 Partial Eta Squared value which shows statistical significance. Therefore, the null hypothesis was rejected. The hypothesis showing a significant difference in off task behavior between fourth grade students seated on air-filled disks after previously being seated on rigid plastic chairs versus students who continue to be seated on rigid plastic chairs was accepted. The type of seating had a positive impact on

on-task behavior for fourth grade students. If teachers are concerned about improving on-task behavior in their classroom, modifying the static seating to a more dynamic seating is something to consider.

**Academic achievement.** As noted previously, the instructors did not change any teaching methods between baseline and intervention phases. The cumulative effect of off task behaviors on academic achievement was measured by daily averaged grades for three core subjects (a) reading, (b) math, (c) and writing. Grading rubrics are dictated by the district and therefore consistent between instructors. Journeys Reading Series is used in the district where the research took place. This series is published by Houghton Mifflin Harcourt. There are extended learning opportunities for advanced learners and Response to Intervention (RtI) strategies for struggling learners.

**Control classroom reading.** In the control classroom, grades for reading averaged 93.28 between the nine students who were part of the control group during the baseline phase. The range was 86.50 to 97.80. Figure 13 shows the control class-reading baseline.

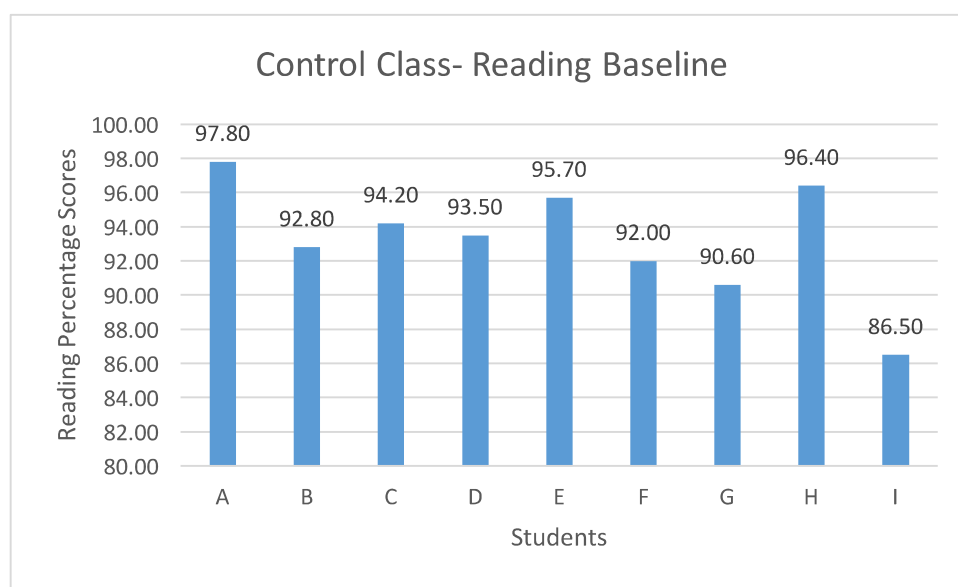
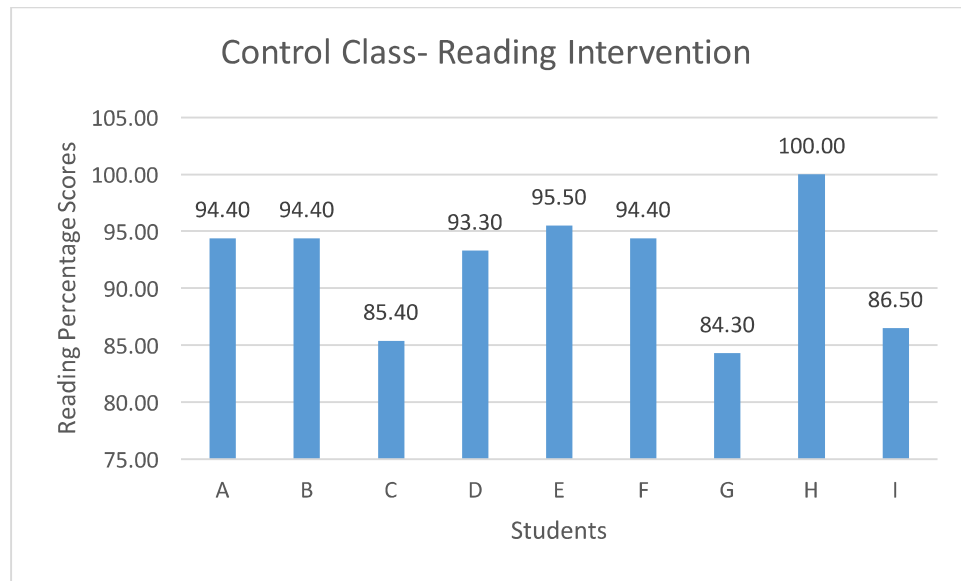


Figure 13. Control Class- Reading Baseline.

During the intervention phase, grades for reading averaged 92.02 between the nine students who were part of the control group during the intervention phase. The range was 84.30 to 100.00. This is a decrease in 1.26 percentage points. Figure 14 is the control class- reading intervention.



*Figure 14.* Control Class- Reading Intervention.

Five of the nine students had a decrease in reading scores in the control classroom between baseline and intervention phases. This equates to 56% of the students involved in the control classroom for the research study. Figure 15 shows individual comparison between baseline and intervention for the control classroom in reading scores.

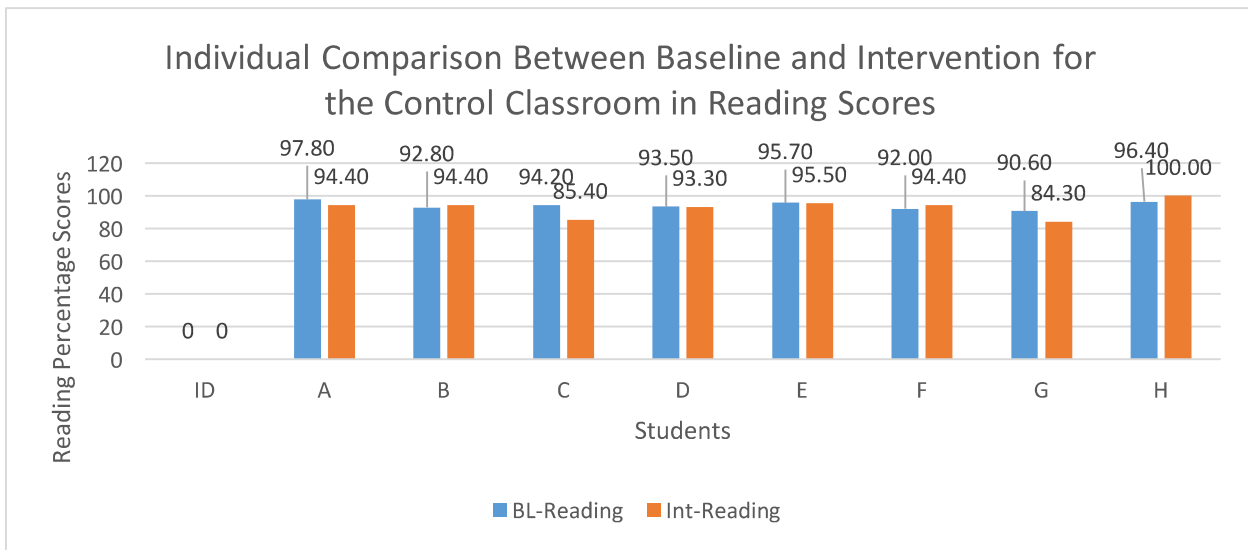


Figure 15. Individual Comparison Between Baseline and Intervention for the Control Classroom in Reading Scores.

**Experimental classroom reading.** In the experimental classroom, the grades for reading averaged 93.78 during baseline with a range of 83.00 to 100.00 for the 17 students who were enrolled in the study. This is .50 percentage points higher than the control classroom scores for reading during baseline.

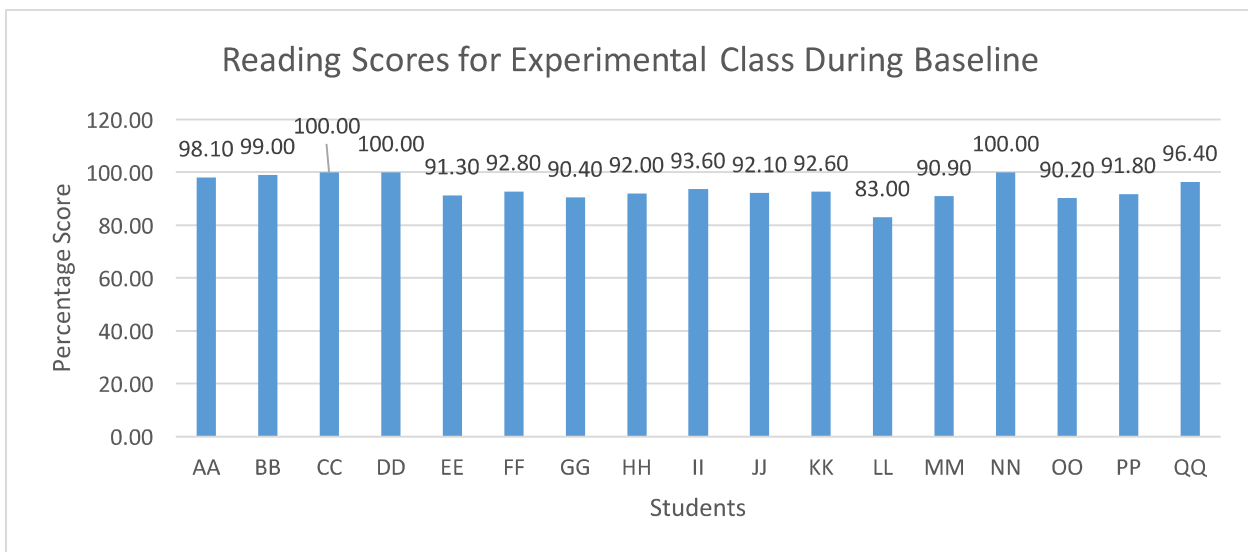
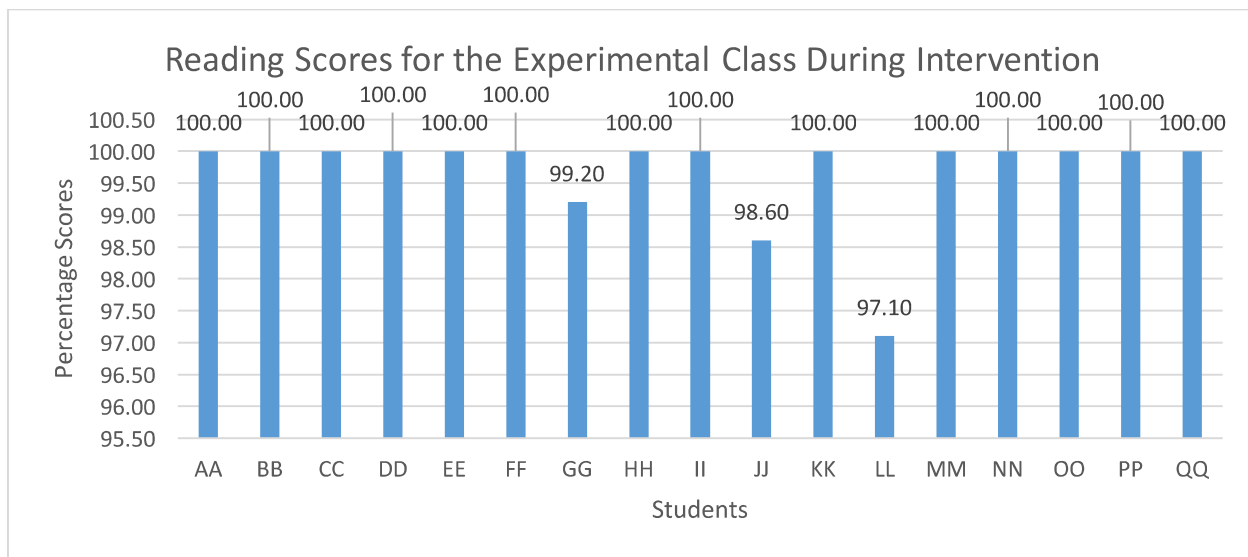


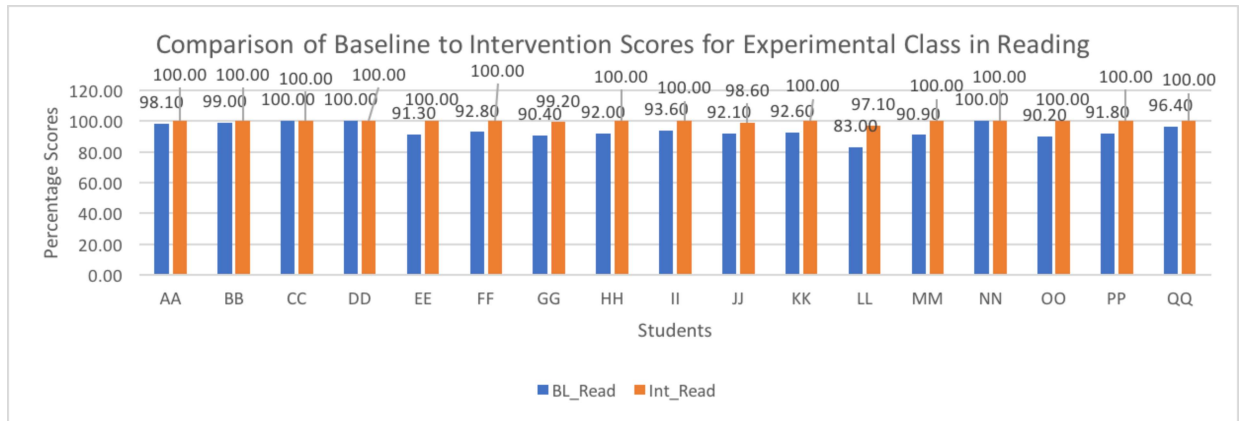
Figure 16. Reading Scores for Experimental Class During Baseline.

During the intervention phase, the scores ranged from 97.10 to 100.00 with an average of 99.70 for the 17 students in the experimental classroom. This is 7.68 percentage points higher than the intervention phase of the control classroom. Figure 17 shows the reading scores of the experimental classroom during intervention.



*Figure 17.* Reading Scores for the Experimental Class During Intervention.

In the experimental classroom, zero students had a decrease in reading scores between baseline and intervention. Three students' scores remained the same and 14 out of 17 had an increase in reading scores between baseline and intervention.



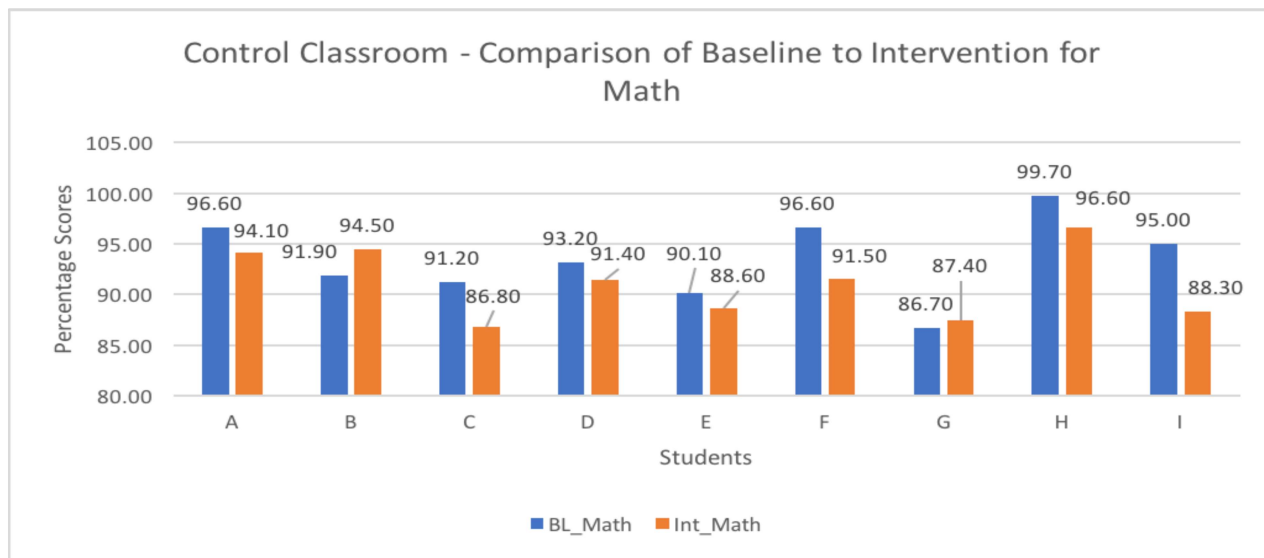
*Figure 18.* Comparison of Baseline to Intervention Scores for Experimental Class in Reading.

The addition of dynamic seating was shown to improve academic achievement in the area of reading for fourth grade students as evidenced by the results between the control and experimental classes in this study.

***Academic achievement in math.*** Fourth graders in the research district are all taught the same math using the same series with extended learning activities for advanced students and RtI strategies for struggling students. Pearson’s Envision Series is used and all teachers are trained through required professional development for teaching strategies.

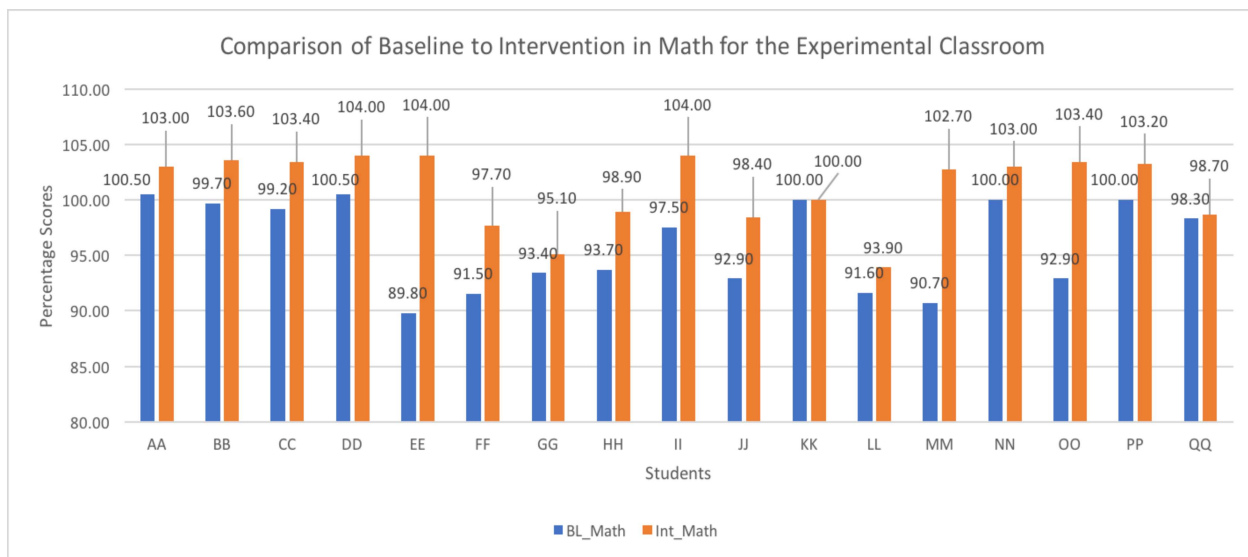
Control classroom math. In the control classroom, seven of the nine students decreased their scores in math between baseline and intervention. The average score for math in the control classroom during baseline was 93.44 with a range of 86.70 to 99.70. During the intervention phase the average score for the control classroom was 91.02. The range during intervention was 86.80 to 96.60. This was a 2.42 decrease in percentage points for the control classroom between baseline and intervention. Figure 19 displays the

control classroom- comparison of baseline to intervention for math.



*Figure 19.* Control Classroom - Comparison of Baseline to Intervention for Math.

In the experimental classroom, the average score for baseline in Math was 96.01. The range was 89.80 to 100.50. During the intervention phase, the average score was 101.00 with a range of 93.90 to 104.00 in the experimental classroom. This was a 4.99 percentage point increase in math scores for the experimental class during the intervention phase. Zero students had a decrease between baseline and intervention scores and one student remained the same.



*Figure 20.* Comparison of Baseline to Intervention in Math for the Experimental Classroom.

The control classroom had a 2.42 decrease in percentage points between baseline and intervention and the experimental class had a 4.99 increase in percentage points between baseline and intervention. The addition of dynamic seating was shown to improve mathematic achievement in the area of mathematics for fourth grade students as evidenced by the results between the control and experimental classes in this study.

**Writing.** The school district participating in this research design uses a rubric to score writing achievement. All teachers are given continuing professional development on how to score and once a year all teachers get together and group score student writing to ensure consistency. The fourth-grade teachers use the district rubric for scoring writing each week. The students in the control and experimental classrooms were given the same assignments relative to their own skill levels.

**Writing scores for the control classroom.** The average score for writing in the control classroom during baseline was 96.83 with a range of 92.00-99.20. During the intervention phase the average score was 97.90 with a range of 93.70-100.00. This was an

increase of 1.07 percentage points between baseline and intervention for the control classroom. Two students had a decrease in writing scores between baseline and intervention and seven students had an increase in writing scores. Figure 21 displays the data for baseline to intervention scores for writing.

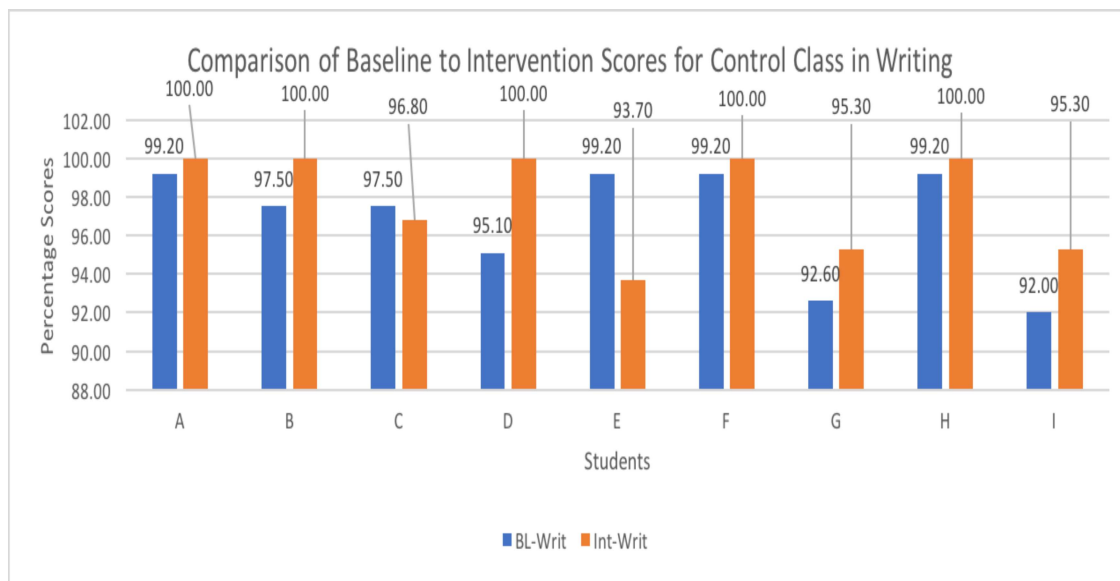
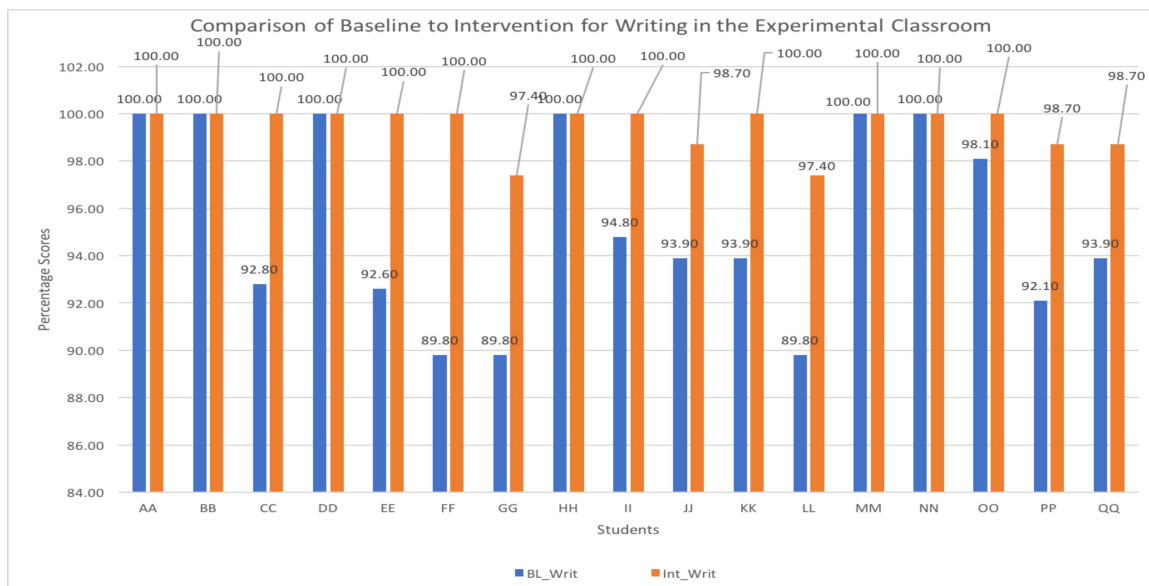


Figure 21. Comparison of Baseline to Intervention Scores for Control Class in Writing.

**Experimental classroom writing results.** The average score for writing for the experimental classroom during the baseline phase was 95.38 with a range of 89.80-100.00. The average score for writing during the intervention phase was 99.46 for the experimental classroom. The range was 97.40-100.00. This was an increase in scores 4.08 percentage points. Zero students had a decrease in writing scores between baseline and intervention. Six students maintained the same score in Math between baseline and intervention. Figure 22 displays eleven student scores increased between baseline and intervention for writing in the experimental classroom.



*Figure 22. Comparison of Baseline to Intervention for Writing in the Experimental Classroom.*

***Comparison of writing scores between the control and experimental classroom.***

The control classroom writing scores were 96.83 on average during baseline and the average scores for writing for the experimental classroom were 95.38. The control classroom began the experiment with higher writing scores than the experimental classroom. After intervention, the control classroom average scores were 97.90 and the experimental classroom was 99.46 for writing. The addition of air-filled disks to static chairs positively impacted the growth of writing for the experimental fourth grade classroom.

***Implications for academic achievement utilizing dynamic seating.*** The introduction of air-filled disks for dynamic seating to the standard static chairs used in fourth grade classrooms improved the academic achievement of the core subjects of reading, math, and writing. Students were more on-task when they had the ability to wiggle comfortably in their seats and this had a positive outcome on their scores. Wiggling on a hard surface is not comfortable. Educators who are wanting to improve

reading, writing, and math scores should consider adding dynamic seating choices to their classroom to enhance student participation in learning. The comfort level for the students during their seven-hour day is enhanced by allowing for more movement. Students reported loving the cushions and hoping their next year's teacher would utilize the cushions as well.

### **Recommendations**

*Recommendations for practice.* As new schools are built, student seating comfort should be a consideration. This research indicates a high correlation between student comfort and decreased off-task behaviors and increased academic achievement. For those educators who are in existing schools, they should consider procuring alternative seating for their students. This researcher chose the air-filled disks for the following reasons (a) inexpensive cost, (b) durability, (c) ease of storage, and (d) ability to adjust for student preference. There are other dynamic seating choices that would provide similar proprioceptive movement; however, the cost, durability, storage, and adjustment issues may not be as positive.

Educators should consider movement needs when planning lessons. These can be built into the day through preplanned activities or by providing a variety of seating choices throughout the room and giving students permission to move. Some of the other cushions that will work for providing comfort are (a) camping cushions, (b) kitchen cushions, (c) garden kneeling pads, (d) padded bar stool covers, or (e) stadium seating cushions. While none of these choices provide the side to side proprioceptive movement afforded through the air-filled disks, they will provide comfort to the static condition of the current chair. Teachers can also provide a standing work station in the classroom.

This can be a counter height table with space for four students who need to stand to do their work. This is not a punishment choice, but a preference choice. Also, teachers could consider having extra desks in the room and allowing those students who need to move permission to get up and move to an alternative desk for a period of the day.

**Recommendations for future research.** Several variables that might have made a difference in the outcome of the study (a) scale and (b) training of other educators to record data. Based on the positive results of this research, further studies should be performed which consider dynamic seating in the classroom.

*Scale.* It was extremely difficult to get parents to sign the consent forms despite having full administrative and district support for this research. Based on previous experience with notifications that go home from the school, many of which need constant reminders to be signed and dated, this was not unexpected. Getting parents to remember to send in items whether sent home in the backpack or mailed through the United States Postal Service is very difficult. Families are busy with work, after school activities, and sports; therefore, pieces of mail can become lost in the process only to be found much too late.

This study would benefit from a larger scale roll out to determine the effectiveness not just in the fourth grade, but in all grades. This would require a district push and possibly having parents sign up when they come in to sign their children up over the summer at enrollment. If parents are asked in person, they are more likely to sign up and not forget to participate. This would eliminate the need for mailing the consent and expecting parents to mail the forms back in. Several forms were returned after the

deadline and data collection had already begun. The control class parents were not as enthusiastic to be involved since their children were not receiving treatment.

**Training.** It was extremely time consuming to watch video each evening and weekend to analyze data for two classrooms. While this ensured reliability in measuring off task behaviors, few researchers would give up sleep to go through more than one class of data per evening. This would involve training other educators what to watch for in (a) fidgeting inappropriately, (b) out of seat behavior not appropriate to activity, and (c) blurting out of turn so that the recording was consistent. Interobserver reliability would have to be employed as well to insure the other researchers were recording the same.

Another method for data collection would employ graduate students who were full time students to be seated in two separate classrooms all day and collect the data in real time. Perhaps a group project thesis could be utilized this way. Again, interobserver reliability would have to be employed to ensure each researcher was collecting data in the same manner. Another potential pitfall to this method would be the Hawthorne Effect changing the outcome of the results. Many teachers comment about students who have behavioral issues, yet when the behavior therapist comes to visit the student has perfect behavior. The Hawthorne Effect describes the phenomenon of behavior of anyone being different when that person knows they are being observed.

**Additional research recommendations.** One potential recommendation for the cushions revolves around this researcher's desire to keep the cushion attached to the chair necessitated the sewing of seat sized pockets to slide the cushion inside. This alleviated several potential issues (a) the throwing of the cushions like a frisbee, (b) slipping off the chair, (c) sticking to the student when wearing shorts or skirts, and (d) causing the student

to slip off the seat if the cushion slid to one side or the other from movement. The cushions were inexpensive as durable denim was used and can be used for many years to come. The denim is washable should spills arise. Not all teachers are seamstresses nor desire to spend spare time or money investing in this activity. This was a personal preference of this researcher and most likely had minimal impact on the successful use of the cushion in the classroom.

The air-filled disks are one of the cheapest alternative seating choices compared to yoga balls, nodes desks, standing desks, and other forms of wiggle seats, they are still approximately \$10-\$14 each. One possible solution to the cost is to utilize several grant opportunities available in most districts. Another current option is to use the website [www.donorschoose.org](http://www.donorschoose.org). This website allows people to purchase items for classrooms at no cost to the educator. In many cases, strangers fulfill the wishes of the classroom in a very brief time. It requires little effort on the teacher's part and 30 cushions would be a viable choice. Amazon is a vendor on the Donor's Choose website and Amazon has a plethora of choices for air-filled cushions available. The purchase of cushions for this researcher's classroom was fulfilled by a small grant available within the Parent Teacher Organization (PTO).

The current study provides several implications for subsequent research. First, a research study that utilizes a return to baseline with different seating types could be of benefit to the field. For instance, six weeks of air-filled disks could be added, then return to the static chairs for three weeks. During the second quarter of the year, the introduction of the Yoga Balls could be introduced for six weeks, and then return to the static chairs for three weeks. During the third quarter of the year, the introduction of standing desks

could be introduced for six weeks, and then return to the static chairs and desks for three weeks. During the final quarter, the introduction of Stability-T stools could be introduced for three weeks and then return to the static chairs for the last three weeks. After a full year of data collection, each choice could be compared to the other and a determination on which was most effective could be discussed.

Four different classrooms could be involved in the study by rotating the different tools between the four classes. It would behoove the researchers to make note of which type of seating each individual student fared best with because it is probably an individual preference and need that determines the effectiveness. At the end of the year, the researchers could share which students needed which seating choice and those tools could go with them to the next grade level. A longitudinal study could then be conducted on the effectiveness of allowing each student to remain seated on their own tool for an entire year.

The potential pitfall of this proposed research is again the cost of purchasing four sets of seating choices. It would require much planning and grant writing to acquire such a large quantity of supplies. This would limit the research ability in poorer districts where grants are harder to obtain.

Perhaps, studying another component such as vestibular input or height of the seat should be considered in future research. In Iceland, the students are seated on padded barstools which allow for proprioceptive and vestibular movement (Petursdottir, 2015, personal correspondence). The barstools also raise them up to eye-level with the white board. The area of vestibular input and height could also impact the achievement scores of students.

Additionally, this research should be carried out in other grade levels to ensure generalization for other age levels of students. A whole district implementation with baseline and intervention scores would be ideal and would further strengthen the need for architects to consider student comfort when designing schools in the future.

### **Conclusions**

The addition of dynamic seating to traditional static seating was of benefit to fourth grade students in two areas (a) off-task behavior and (b) academic achievement. Off task behaviors decreased by 54%. Academic achievement in reading improved by six percentage points during the six-week intervention phase. Academic achievement in math improved by five percentage points during the same period. Finally, academic achievement scores in writing improved by four percentage points. Compared to the scores in the control classroom for the same period, where reading scores decreased by one percentage point, math decreased by two percentage points, and writing increased by one percentage point.

This research indicates consideration of the movement needs of students should be part of lesson planning when teachers consider their environmental set up of the classroom, designing the scheduling of the day, and determining alternative seating needs. Teachers should consider alternative funding sources to procure alternative seating as the current budgets in most school districts would prohibit the purchase of cushions for each student in the school. Grants are available through philanthropic communities and many of these groups enjoy assisting schools with items they need.

Engineers and architects who design school buildings should keep movement needs in mind when purchasing chairs and designing how students will move throughout

the building. Companies who provide equipment for schools should consider cost productive ways to build dynamic seating into the current seating trends and make the affordable to school districts. There are many alternative seating choices in special education catalogs with prohibitive price tags that are not viable for most school districts.

If behavior is to change and academic achievement is to increase it is the school that must change first. Providing an environment that encourages movement through dynamic seating allows students to increase their synaptic plasticity (Patten et al., 2013). When the left and right side of the brain are connected through movement, it allows the students to make connections to their learning and retain more information (Kilbourne, 2011). It is believed the students would have gained higher results had the research been conducted for more than six weeks. In the future, a yearlong study comparing average grade scores from the previous year would be of high interest to many researchers. It is also believed the control classroom parents might have been more agreeable to participate if they had been promised the addition of air-filled disks once the intervention trial was completed.

As an educator, this researcher found the decrease in off-task behavior and the improved academic achievement scores were highly beneficial to the students and the test scores received at the end of the year. The students scored higher than expected on tests, were less likely to stare into space, and more likely to remember to wait to be called on when asked questions that were not every pupil response questions. As stated previously, it is presumed the scores would continue to have increased if the data collection had gone on beyond the six-week mark. The information gained from this research will be shared with all staff in the fall with a few students reporting how it helped them.

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## Appendix A: Informed Consent Form for Teachers

### **Introduction:**

My name is Jessica Eggleston. I am a doctoral student at Northcentral University. I am conducting a research study on how effective dynamic seating is with classroom off-task behaviors. I am completing this research as part of my doctoral degree. I invite you to participate.

### **Activities:**

If you participate in this research, you will be asked to:

1. Allow data collection on off-task behaviors within the classroom to be taken within the classroom
2. Provide baseline data of the grades of core subjects every week

### **Eligibility:**

You are eligible to participate in this research if you:

1. Are a fourth-grade teacher in the Midwest School District for at least 3 years
2. Certified in elementary education
3. Teach in the fourth grade and have at least 3 years' experience in the grade level

You are not eligible to participate in this research if you:

1. Educator in another district

I hope to include 1 other teacher in this research.

### **Risks:**

There are minimal risks in this study. Some possible risks include: longer waiting time for transitions for data collection.

To decrease the impact of these risks, you can: stop participation at any time.

### **Benefits:**

If you decide to participate, the direct benefits to you will be to see if dynamic seating allows for fewer off-task behaviors.

The potential benefits to others are: students have on-task behavior.

### **Confidentiality:**

The information you provide will be kept confidential to the extent allowable by law. Some steps I will take to keep your identity confidential are: I will not ask for names and I will use fake numbers to assign to random students and teachers.

The people who will have access to your information are: myself, my dissertation chair, and my dissertation committee. The Institutional Review Board may also review my research and view your information.

I will secure your information with these steps: data collected from fourth grade students' grades, disruption tally marks, and student identifiable numbers will be locked in a filing cabinet, and transporting it in a locked case.

I will keep your data for 7 years. Then, I will delete electronic data and destroy paper data.

**Contact Information:**

If you have questions for me, you can contact me at: [Jessica.Eggleston@ncu.edu](mailto:Jessica.Eggleston@ncu.edu)

My dissertation chair's name is Candace Mazze. She works at Northcentral University and is supervising me on the research. You can contact her at: [cmazze@ncu.edu](mailto:cmazze@ncu.edu).

If you have questions about your rights in the research, or if a problem has occurred, or if you are injured during your participation, please contact the Institutional Review Board at: [irb@ncu.edu](mailto:irb@ncu.edu) or 1-888-327-2877 ext 8014.

**Voluntary Participation:**

Your participation is voluntary. If you decide not to participate, or if you stop participation after you start, there will be no penalty to you. You will not lose any benefit to which you are otherwise entitled.

**Videotaping:**

I would like to use a video camera to record student actions. Because this tape will show who you are, these extra steps will be taken: tapes will be securely transported, labeled with the date, stored, and deleted.

You can still participate if you do not wish to be recorded.

Please sign here if you will allow me to videotape you: \_\_\_\_\_

**Experimental:**

This intervention on how effective dynamic seating is on classroom off-task behaviors. has not been tested before. The purpose of this study is to test to see if dynamic seating will decrease classroom off-task behaviors. You should know that there are other interventions available to you that have been tested before. Some benefits to these are: staying on task, and using classroom time accordingly. If you are interested in this intervention instead, please let me know.

**Signature:**

A signature indicates your understanding of this consent form. You will be given a copy of the form for your information.

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Participant Signature

Printed Name

Date

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Researcher Signature

Printed Name

Date

## Appendix B: Informed Consent Form for Parents

### **Introduction:**

My name is Jessica Eggleston. I am a doctoral student at Northcentral University. I am conducting a research study on how effective dynamic seating on classroom off-task behaviors. I am completing this research as part of my doctoral degree. I invite your child to participate.

### **Activities:**

If participating in this research, your child will be asked to:

1. Sit on a seat disc
2. Go without sitting on a seat disc

### **Eligibility:**

Your child is eligible to participate in this research if:

1. A student in my classroom
2. A student in the controlled fourth grade classroom

Your child is not eligible to participate in this research if:

1. In another classroom other than mine or in the controlled classroom

I hope to include 22 students from my classroom and 23 students from the control classroom in this research.

### **Risks:**

There are minimal risks in this study. Some possible risks include: enjoyment of the seat disc.

To decrease the impact of these risks, your child can stop participation at any time.

### **Benefits:**

If your child decides to participate, the direct benefits to your child are: staying on task, less off-task behaviors within the classroom, and receiving a beneficial education.

The potential benefits to others are: helping other researchers, teachers, and educators with valuable information that will help with a student's need within the classroom.

### **Confidentiality:**

The information your child provides will be kept confidential to the extent allowable by law. Some steps I will take to keep your child's identity confidential are: I will use a fake number to identify your child, names of students will not be identifiable in any means, and information regarding this study will kept completely confidential and will not be discussed with anyone outside of the study. Data collected from fourth grade students' grades, disruption tally marks, and student identifiable numbers will be locked in a filing cabinet, and transporting it in a locked case.

The people who will have access to your child's information are: myself, my dissertation chair, other researchers, and my dissertation committee. The Institutional Review Board may also review my research and view your child's information. I will keep the data for 7 years. Then, I will delete electronic data and destroy paper data.

**Contact Information:**

If you have questions for me, you can contact me at: [Jessica.Eggleston@ncu.edu](mailto:Jessica.Eggleston@ncu.edu)

My dissertation chair's name is Candace Mazze. She works at Northcentral University and is supervising me on the research. You can contact her at: [cmazze@ncu.edu](mailto:cmazze@ncu.edu).

If you have questions about your rights in the research, or if a problem has occurred, or if you are injured during your participation, please contact the Institutional Review Board at: [irb@ncu.edu](mailto:irb@ncu.edu) or 1-888-327-2877 ext 8014.

If you have questions about your rights or your child's rights in the research, or if a problem has occurred, or if your child is injured during participation, please contact the Institutional Review Board at: [irb@ncu.edu](mailto:irb@ncu.edu) or 1-888-327-2877 ext 8014.

**Videotaping:**

I would like to use a video camera to record your child's actions. Because this tape will show who your child is, these extra steps will be taken: tapes will be securely transported, labeled, stored, and deleted. Tapes will be labeled with only the date the video was recorded, tapes will never leave my office and will be locked at all times. The key for where the tapes will be stored will be kept in a drawer that has a keypad and in this case the key will never leave my office. I will be the only one that knows the keypad code.

Your child can still participate if he/she does not wish to be recorded.

Please sign here if you will allow me to videotape your child:

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Parent Signature	Printed Name	Date
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**Voluntary Participation:**

Your child's participation is voluntary. If your child decides not to participate, or if your child stops participation after starting, there will be no penalty to your child. Your child will not lose any benefit to which he/she is otherwise entitled.

**Signature:**

A signature indicates your understanding of this consent form. You will be given a copy of the form for your information.

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Parent Signature	Printed Name	Date
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Researcher Signature	Printed Name	Date
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