

The Use of Sensory Balls in the Classroom: Effects on Behavioural and Academic Functioning of Students with Learning Disabilities

Grace Annammal Piragasam, Norfishah Mat Rabi, Abdul Halim Masnan

To Link this Article: <http://dx.doi.org/10.6007/IJARBSS/v8-i4/4150>

DOI: 10.6007/IJARBSS/v8-i4/4150

Received: 06 Feb 2018, Revised: 27 Feb 2018, Accepted: 26 March 2018

Published Online: 03 April 2018

In-Text Citation: (Piragasam, Rabi, & Masnan, 2018)

To Cite this Article: Piragasam, G. A., Rabi, N. M., & Masnan, A. H. (2018). The Use of Sensory Balls in the Classroom: Effects on Behavioural and Academic Functioning of Students with Learning Disabilities. *International Journal of Academic Research in Business and Social Sciences*, 8(4), 1124–1146.

Copyright: © 2018 The Author(s)

Published by Human Resource Management Academic Research Society (www.hrmars.com)

This article is published under the Creative Commons Attribution (CC BY 4.0) license. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this license may be seen

at: <http://creativecommons.org/licences/by/4.0/legalcode>

Vol. 8, No. 4, April 2018, Pg. 1124 – 1146

<http://hrmars.com/index.php/pages/detail/IJARBSS>

JOURNAL HOMEPAGE

Full Terms & Conditions of access and use can be found at
<http://hrmars.com/index.php/pages/detail/publication-ethics>

The Use of Sensory Balls in the Classroom: Effects on Behavioural and Academic Functioning of Students with Learning Disabilities

Grace Annammal Piragasam, Norfishah Mat Rabi
Department of Special Education, Sultan Idris Education University, Malaysia

Abdul Halim Masnan
Department of Early Childhood Education, Sultan Idris Education University, Malaysia

Abstract

The purpose of this study is to investigate class-wide effects using an A-B-A-B reversal design, examining the effectiveness of sensory balls in comparison to classroom chairs in a special education classroom. Students' on-task and out-of-seat behaviour were measured using behaviour observation ratings. The writing productivity were measured using *Kurikulum Standard Sekolah Rendah Pendidikan Khas*. Participants in the study consist of eight students with learning disabilities (ADHD and ASD). During baseline, students were seated on their traditional classroom chairs. During the intervention periods, typical classroom seating were replaced with sensory balls. The students undergo a maintenance phase similar to baseline phase and their behaviour as well writing productivity were observed. Sensory balls showed favourable improvements over baseline both on-task (overall mean baseline $M=43.70$) relative to intervention ($M=59.55$) and out of seat behaviour more effective than chairs with greater variability (overall mean baseline $M=3.79$, intervention $M=2.40$). Results also demonstrated slight improvement in writing productivity with accuracy over the course of the study and were comparable for both types of seating. Social validity measures indicated moderate levels of acceptability of sensory balls in the classroom among the students. The study is fundamental for many students in the special education classroom who encounters difficulties to outlet their energy (slight bouncing), and increase the amount of time they are able to focus. Therefore, this study is beneficial in special education classroom with students of different disabilities and diagnoses. Future research direction on sensory-motor activities may expand the relationship between the use sensory integration materials in special need classroom and its outcome on the students functioning and development.

Keywords: Learning Disabilities, Behaviour, Academic, Sensory Ball, Educational Therapy

Introduction

Sensory balls are used for a variety of reasons including exercise and, most recently, as a seating option to help children pay attention (Dibitetto, 2015; Mead, Scibora, Gardner & Dunn, 2016). According to Dibitetto (2015), this type of seating is a cost-effective intervention that allows children to engage in minimal physical activity while maintaining an optimal arousal level suggested by researchers. It is important to note that staying seated and focused on tasks is critical while in school, but it is equally important during other times of the day when the child is at home, or in therapy settings.

Furthermore, it is theorized that a student can maintain concentration while seated on the sensory ball because the unstable surface requires continuous, yet minor movement. In a sense, the sensory ball allows the student to “fidget” or move their body inconspicuously, which then helps the student to stay focused while seated. To allow controlled movement needed for fine motor activities, the human body must have a stable center from which the head and limbs can move (Green & Roberts, 2015; Valentini, Pierosan, Rudisill, & Hastie, 2017). This suggests that appropriate seating can influence a child’s postural control and how he or she effectively uses his or her hands (Livingstone & Paleg, 2014). Effective use of the limbs and hands allow for better control of writing materials.

Sensory balls are also being used in certain school districts within Malaysia. Sensory ball is known as equipment for rehabilitation or therapeutical purposes. In Malaysia, services rendered by therapists or rehabilitation physicians are centred in a clinical or community based services settings. These centres are located out of the school environment; they are based in hospitals or centres providing related services to individuals with special needs (MyHEALTH, 2017). Hence, sensory balls have been commercialized, their use has become widespread, and they are promoted as an effective intervention both individual and class wide level. Sensory balls are often available in the classroom setting as a teaching aid for selected subjects in special education mainly for physical education and manipulative skills.

Despite of the broad findings on the positive effects of sensory balls for the special education needs students, special education teachers lack knowledge and skills to utilize it. (Kafka and Limberg ,2013; Sugden & Wright, 2013). Sensory balls are used as like any typical ball by special education teachers. The understanding on the role of therapists in Malaysia is also surrounded in the hospital and centres for rehabilitation. Nevertheless, therapeutic services in special education programme are currently provided in selected schools on interim basis.

In the case of referral to therapist by doctors, it is the duty of the parents to take their children with special needs for follow ups and the gap between each session is quite huge. The scenario depicts the requirement to implement consistent therapeutical activities transferred into classrooms during lessons to enable more students benefit from such effective and direct intervention (Pagliano, 2017). Currently, research investigating the use of sensory balls in the classroom setting is unlikely to be explored in Malaysia’s education context. Not only is the amount of research lacking, but also the methodologies used and populations have varied limiting both generalization and conclusions. In addition, most researches are student oriented and classroom wide needs greater attention with the increase of students with education needs in Malaysia (Buku Data Pendidikan Khas, 2016).

The few published studies have focused primarily on students with disabilities particularly among autistic spectrum disorder (ASD) and attention deficit hyperactive disorder (ADHD) using

targeted implementation and have utilized varied methodology (Case-Smith, Weaver, & Fristad, 2015; Foley Nicpon, Allmon, Sieck, & Stinson, 2011; Wang & Reid, 2011). Furthermore, sensory balls have been popularized as a class wide intervention strategy yet there are no published studies that have documented class wide effects. Therefore the purpose of this study was to determine the effectiveness of sensory balls at a class wide level and an attempt to provide empirical support for their use in the classroom. This study examined the effectiveness of sensory balls in comparison to classroom chairs using direct behavioural observation, teacher behaviour ratings, and assessment of academic productivity.

Focus of the Study

Focus of the study was to look at the effects of sensory ball seating on attending and in-seat behaviour for children with an ASD diagnosis. Furthermore, the study assessed the students' choice of sensory balls versus typical chairs for their seating. By introducing a seating option that allows for movement and modulation the children were expected to choose the ball seat over a typical chair and be less likely to get up in an effort to seek energy release through other activities (Croft, 2016; Rock, Spooner, Nagro, Vasquez, Dunn, Leko, & Jones, 2016). The current study adds to the literature by showing the effects of sensory balls and participant preferences. In addition, academic productivity was assessed by assessing writing skill to document writing fluency. It was hypothesized that students will be on-task more frequently and out-of-seat less frequently when seated on sensory balls in comparison to classroom chairs. In addition, it is hypothesized that students' academic productivity may increase as measured by writing accuracy while seated on sensory balls in comparison to classroom chairs.

1. Is there an improvement on the out of seat behaviour among students while using a sensory ball as compared during the baseline phases (classroom chair)?
2. Is there a improvement on the students' on -task behaviour with the use of sensory ball over time?
3. To what extend does the use of sensory ball improves writing productivity of students with learning disabilities accurately?

Review of Literature

Several studies have looked at the effects of using sensory balls as classroom seating. Several study that focused on many different benefits of using a sensory ball as a classroom chair. These benefits include improved flexibility and range of motion, improved strength and sensory, improved balance, improved posture, and increased ability to stay on task. Students were pre- and post-tested using motor tests including toe touches, trunk rotation, bent-knee push-ups, tandem heel-toe walking, single-foot standing balance, and pivot prone. Students were also observed by video recording to assess squirminess, time on task, and classroom posture.(Al-Eisa, Buragadda, & Melam, 2013; Croft, 2016; Matin Sadr, Haghgoo, Samadl, Rassafiani, Bakhshi, & Hassanabadi, 2017).

Kafka and Limberg (2013), surveyed 62 teachers on the use of sensory balls. One quarter of the respondents said they had used sensory balls in the past and 22% were currently using sensory balls in the classroom. The researchers found that all of the teachers who had

implemented sensory balls as chairs found them effective as an intervention. Kafka and Limberg noted that sitting on a sensory ball activates postural muscle control resulting in better hand coordination. Schilling, Washington, Billingsley, & Dietz (2003) also conducted a study on the use of sensory balls in the classroom, addressing the issue of handwriting directly.

The researchers noted general handwriting improvement in the students after the use of the sensory ball. The literature on handwriting in general and the use of sensory balls in particular seems to indicate that a connection can be made between the amount of time spent on handwriting in an elementary classroom, the importance of handwriting, the influence of posture on handwriting, and how sensory balls can improve posture. Since handwriting makes up a large portion of the elementary student's day, teachers should work to make sure that they are supporting their learners with seating that can improve range of motion and postural control. This study works to explore this idea by comparing two classrooms and their rate of growth in handwriting after using standard classroom chairs or sensory balls.

According to Kilbourne (2009) there is scientific knowledge that exercise benefits teaching and learning. Children are supposed to be active, they move around. A child's ability to pay attention increases when they are given the opportunity to move. The use of exercise balls for chairs in the classroom among students with attention problems could focus better. Children that require extra movement could do so in a quiet manner without disturbing other students. More students become actively engaged in learning when sitting on ball chairs (Boone, 2016).

Enjoyment of Sensory Ball

Some students like bouncing on the balls a little, only small bounces are allowed. Bill (2008) stated students said they feel better when sitting on ball chairs. Students also felt more comfortable and said their backs did not hurt when sitting. The ball chairs are soft compared to regular classroom seats and are more fun to sit on. stated students in her study said the ball chairs are awesome. The ball chairs make me sit up straighter, which improves my back muscles because when students slouch their back hurts. When students are sitting up they can concentrate better and therefore their work improves (Bagatell, Mirigliani, Patterson, Reyes, & Test, 2010). Schilling, Washington, Billingsley, and Deitz (2003) also stated some children said they could keep their brain active even when they were bored. Some students thought they could get their work done better. Work is a lot more fun when you are sitting on a ball chair.

Attention Deficit Hyperactivity Disorder

Children using ball chairs in the classroom appeared to improve in attention, prolonged periods of sitting and school performance. An over active child may be calmed by gently rocking on a ball chair. Shilling and Schwaliz (2004) stated the ADHD child can gently move without moving furniture creating a calmer classroom atmosphere that is also quiet. After using ball chairs students seem to remain calmer and more focused for about 30 to 45 minutes (Schilling et al., 2003).

Re, Lovero, Cornoldi, & Passolunghi (2016) also stated students with ADHD preferred sitting on ball chairs rather than a regular classroom seat for comfort, writing, and productivity.

The students also believed the ball chairs improved their writing, and increased their ability to listen and finish class work. Children with ADHD often experience academic and sensory motor problems that make daily school activities a challenge. In order to help these children succeed in school, schools need to adapt the environment to meet the children's needs. Occupational therapy literature suggests the implementation of sensory modulation strategies in the classroom. One possible strategy is to use ball chairs for classroom seating.

Autism Spectrum Disorder

Coffin, Myles, Rogers, & Szakacs (2016), stated a democratic education is a learning community that recognizes and validates the individuality and responsibility of each participant. Teachers need to embrace, support and understand all diverse groups of students in their classrooms. Teachers that work in inclusive classrooms are concerned about reaching and motivating all students in the classroom. The best teachers are knowledgeable about adapting materials, lessons, instructional arrangements, curriculum goals, and teaching strategies to meet all the academic and social needs of students. Classroom teachers need to be more creative and supply interventions for all students in the classroom.

Gresham (2016) stated autistic children exhibit a wide variety of behaviours and developmental levels. These children have difficulty with engagement, attention, and appropriate behaviour in the classroom. These behaviours often interfere with a student's ability to participate in the mainstream classroom. The law states that Autistic children have a behaviour intervention plan. Often these plans avoid or ignore the sensory issues that underlie the behaviour. When sensory needs are met they can provide the nervous system with the stimuli that the body does require in attaining and maintaining an optimal state of arousal for learning. A ball chair for seating is one way to meet the sensory needs of a child with Autism to attain and maintain an optimal state of arousal.

Sensory ball chairs provide children with autism a healthy, safe and productive posture by giving the child an opportunity to both actively move and maintain an optimal arousal level (Schilling & Schwatiz, 2004). When children are in hard rigid classroom seats they often assume extreme postures in their attempts to move around. Evidence has shown that children with Autism sitting on ball chairs have improved in both in seat behaviour and work production. The children showed an increase in engagement and a decrease in oppositional behaviour. Sensory ball chairs have also been found to be effective with children with varied ability levels. The use of ball chairs in the classroom has created opportunities for high quality instruction to be effective for children with Autism. Sensory ball do not replace high quality instructional strategies but provide increased opportunities for teaching. Teachers and students both reported a preference for the use of ball chairs over traditional classroom chairs.

Time Spent on Fine Motor Activities and Handwriting

Three different studies have been done to determine the amount of time spent on fine motor activities as well as handwriting in elementary classrooms. King, Radley, Jenson, & O'Neill (2017) conducted a study on handwriting instruction by surveying teachers. Based on that survey, the researcher found that 20-60 minutes per week were spent on teaching handwriting in a

Kindergarten classroom. In a study done by McHale and Cermak (1992), a minute-by-minute record was taken, noting the number of fine motor tasks completed in six different elementary classrooms.

Descriptions of the activities were recorded along with the start and stop times. A fine motor task was defined as the major use of one's hands. Based on the observations, the researcher found that 31-60% of the academic day used fine motor activities with ten percent of that time spent on pencil and paper activities. One more study conducted by Marr, Cermak, Cohn, and Henderson (2003) compared the time spent on fine motor activities in a head start classroom and a Kindergarten classroom.

Together these three studies highlight the amount of time spent on both fine motor activities and handwriting. Fine motor activities are included in daily activities, education, play, and social participation (Marr, Cermak, Cohn & Henderson, 2003). One of the most common fine motor activities is handwriting. With fine motor activities and handwriting being so prevalent, failure to produce efficient handwriting may have negative effects on academic success and self-esteem (Feder & Majnemer, 2007; Molitor, Langberg, Bouchtein, Eddy, Dvorsky, & Evans, 2016).

Errors made when in special needs classes can lead to struggles later in both reading and handwriting (Feder & Majnemer, 2007). Writing difficulties may also have connections to lower math achievement, lower verbal IQ, and attention issues (Feder & Majnemer, 2007; Rock Berninger, Abbott, Cook, & Nagy, 2017). If students struggle with handwriting, they may not produce adequate proof that they understand material, which may lead teachers to assume a child does not know concepts or skills (McHale & Cermak, 1992). As children grow older, the amount of work that is required also increases and if children have writing difficulties, it may be difficult to keep up.

Methodology

An A-B-A-B reversal design (Rubin & Babbie, 2016) was used to determine the efficacy of implementing sensory balls to improve on-task and out-of-seat behaviour and academic productivity. This research design allows for sequential application, comparison of effectiveness, and intra-subject replication of intervention effects (Barlow & Hersen, 1984). The study included four phases that included A) baseline, B) sensory balls, A) baseline, and B) sensory ball procedures reinstated. Sessions occurred for a total of five weeks. During each session, student on-task and out-of-seat behaviour were observed and the teacher completed an observation form. Students completed writing prompts administered in a classwide setting. During baseline sessions, classes were conducted as usual while student behaviour was observed by data collectors, their behaviour rated by the teacher, and their writing productivity was measured by teacher while seated on traditional classroom chairs. Initial baseline phase (A) lasted for five sessions.

After the first baseline condition, classroom chairs were removed and replaced with sensory balls (B) for five sessions equally. Student behaviour was observed and rated, and students completed writing prompts. Then sensory balls were removed and each student returned to sitting on their typical classroom chair (A) for five sessions. After returning to

baseline, sensory balls (B) were reintroduced for five sessions followed by another 5 session for the maintenance phases until the conclusion of the study.

Participants and Setting

The study included eight children, ages 8 to 12 years who are currently placed in the special education integrated program classrooms. The students are medically diagnosed as learning disabled and all were identified for showing difficulty in attending during seated tasks, as well as showing difficulty remaining seated for more than 5 minutes. The children needed to be able to sit upright on a ball without assistance in order to be included in this study. Participants needed to have acquired receptive language, capable of complying with one step directions. Students with physical disabilities, unable to sit upright on a ball, or who were unable to complete simple compliance tasks were not included.

Consent was received from the Ministry of Education Malaysia (MOE), District Education Office of Larul Matang Selama, Taiping, as well the principal of the school of each participant after a meeting in which the study was thoroughly explained. The study took place in the environment where the child had been encountering problems in the school particularly in the classroom. The initial stage of the entire setting and instructional sessions using sensory ball were recorded and were referred to a therapist for technical and procedural precisions verification.

Materials

Students used traditional classroom chairs and sensory balls as seating throughout the course of the study. During baseline, students were seated on their traditional classroom chairs (i.e., four-legged chairs with backrests). These chairs were made available by the school and accompanied each student's desk. For intervention conditions, typical classroom seating was removed and replaced with sensory balls. These sensory balls were designed for occupational therapy purposes and had cylindrical feet to deter the balls from rolling when not in use.

Standardized observation forms (Suen,2014) were used to directly observe on-task and on-seat behaviour while students were seated on classroom chairs and sensory balls. Each observation form included a section for session information (date of observation, time, observer name, observation phase) and boxes defined by 10-second intervals for each behaviour. For each observation, observers used a programmed interval timer to alert the observer at the beginning and end of each 10-second interval with a short vibration. Throughout the course of the study, a second observer simultaneously completed the observation form to assess inter-observer reliability (Chafouleas, Riley-Tillman & Christ, 2010) at the end of each observation session.

During each session, students were taught Bahasa Melayu according to the standard primary school curriculum for special education (*Kurikulum Standard Sekolah Rendah Pendidikan Khas*). Immediately following the observation sessions, students were administered with written expression by the researcher. Each student was given a pencil as well erasers lined paper. Each lesson is conducted based on the learning standards which have been already outlined and documented for nationwide standardization. In this particularly study, the topic is focused on vocal and consonants blended vocabulary. Students will be introduced with series of varied

pattern of vocabulary (within the range of vocal-consonant-vocal-consonant and vocal-consonant-vocal-consonant-vocal sequences). Each writing probes were dictated using a standardized writing protocol. Throughout the course of the study, a second observer simultaneously completed the writing protocol to assess the procedural integrity of the administration during writing probe administration.

Data Collection Procedures

For the purpose of this study, the use of sensory balls served as the independent variable. On-task and out-of-seat behaviour, and academic writing productivity served as dependent variables. Data collection occurred for five sessions each week during the same writing period across 5 weeks. Thirty minute behaviour observations were completed during a continuous writing lesson and writing probes were administered immediately following behavioural observations. The writing exercises were administered to measure students' academic productivity particularly the ability to write down series of vocabularies with varied combination of vocals and consonants.

During behavioural observations, observers recorded the occurrence and non-occurrence of on-task and out-of-seat behaviours in the classroom. A 10-second interval system was used to observe student behaviour on a round-robin basis. Each 30-minute observation session was divided into 10-second intervals resulting in 120 intervals. Student on-task behaviour and out of seat was evaluated was recorded at the beginning of each 10-second interval using standardized observation form. *On-task* behaviour was defined as the student when the student is in the designated area of the room, oriented toward the teacher or task, following instructions, participating as instructed, engaged with appropriate materials, and seeking help in an appropriate manner (for example: raising hand; Regan, Mastropieri, & Scruggs, 2005).

Concurrently, students' out-of seat behaviour was measured using partial interval recording. That is, the observer recorded the occurrence or non-occurrence of out-of-seat behaviour if it occurred at any time throughout each 10-second interval. *Out-of-seat* behaviour was defined as the student leaving the seated position during instruction and walking within the classroom (i.e., wandering) or out of the classroom without permission. Exceptions included occasions in which a student leaves his or her seat with permission from the teacher. Permission from the teacher was defined as raising one's hand or approaching the teacher and receiving consent to engage in the behaviour (Barrish, Saunders, & Wolf, 1969; Medland & Stanchnik, 1972). Following each session, the total occurrence of each target behaviours was counted and divided by divided by the total number of intervals to determine the percent of intervals in which the behaviour occurred.

Interval Calculation Method for Behaviour Assessment

Interval recording and time sampling methods of observation are designed to estimate the actual occurrence of behaviour. Rather than noting the frequency or duration in which a behaviour occurs, an observer records a target behaviour during a predetermined time period (30 minutes). The time period is then divided into equal intervals (10-second intervals) in which the occurrence

of a behaviour is recorded and the behaviour occurrences are represented as a percentage of occurrences within the observational period (Cooper, Heron, & Heward, 2007).

Training

One postgraduate teacher conducted the lesson throughout the course of this study. The author led two 1-hour training sessions to allow data collectors to practice the procedures and to reach a minimum of 80% agreement prior to data collection. The team researchers met their consensus regarding the overview of the study and description of procedures including direct observation methods, behaviour definitions, and administration and scoring criteria of writing productivity. Subsequently, observers used 2 videos to practice observation of students' behaviour and writing productivity. Prior to that, the videos were sent to a therapist for verification purposes on the procedural precisions. Five writing probes were also used to practice collecting procedural integrity and practice scoring total words written accurately for *Kurikulum Standard Sekolah Rendah Pendidikan Khas Bahasa Melayu Tahun Empat* in written expression of vocabularies involving vocal and consonants

Each observer's data were compared to an answer key to measure inter-observer reliability. That is, inter observer agreement was calculated on a point-by-point basis by dividing the total number of agreements by the total number of agreements plus disagreements (total intervals) and multiplying by 100. The mean inter-observer agreement for training observation sessions was 83%, ranging from 80% to 86%.

Procedures

Baseline (Standard Classroom Chairs)

During baseline, the postgraduate teacher was instructed to conduct his class as usual. Classroom activities, teacher behaviour, and seating were not altered. During a continuous writing lesson, trained observers recorded the occurrence and nonoccurrence of on-task and out-of-seat behaviours in the classroom twice per week. Individual student data were not collected for these measures. Instead, observers alternated every 10 seconds and reported a total of each behaviours by all observed students. Following each behavioural observation a, writing prompts were administered in which students were given writing tasks based on the vocabularies introduced during the lesson of each session. After writing tasks were collected, the administrator counted the total number of words written by each student.

Intervention (Sensory Balls)

Aside from the apparatus students sat on at their desks, the same assessment procedures were used during baseline (i.e., classroom chairs) and intervention (i.e., sensory balls). While students were seated on sensory balls, observers recorded occurrences and non-occurrences of on-task and out-of-seat behaviour. After each observation, students were asked to complete a writing task on vocabulary. Sensory balls were then removed and classroom chairs were reinstated. Following return to baseline sessions, sensory balls were reintroduced and served as the concluding condition of the study.

Maintenance

The maintenance phase also measures students on seat and on task behaviour after which the intervention is retained. The writing task which students' are required to do accomplish are picked randomly of any of the vocabulary which were administered during both the intervention phases.

Academic Productivity (Writing)

In addition to behavioural observation, investigating student's academic productivity while seated on stability balls may also be useful. In addition to improving student behaviour, recent survey results (Olso, Lamminen & Panahon, 2014) indicated that academic productivity was another purpose of implementing stability balls in the classroom. Thus far, only one study has investigated the effects of stability balls on academic performance through legible handwriting (Schilling et al., 2003). Although this study showed favorable results, handwriting is only a subskill of the more broad academic area of written expression.

Hosp, Ford, Huddle & Hensley (2017), extended previous research to academic performance in writing expression could be assessed using curriculum-based measurement. Curriculum-based measurement is an approach designed to evaluate the progress of students in basic academic skills through the use of standardized assessments developed from a school's curriculum (Jung, McMaster, & Delmas, 2017)

Data Analysis

Throughout the study, data were visually analyzed after each session to assess the level and trend of the data to determine phase changes. In addition, visual analysis was used to determine which seating method was most effective at improving student behaviour and writing productivity. Results of this study were examined using certain characteristics to determine intervention effectiveness including average of each phase, change in level of performance from one phase to the next, trend in performance across phases, and percentage of non overlapping data (PND; Cooper et al., 2007; Kennedy, 2005; Michiels, B., Heyvaert, & Onghena, 2017; Richards, Taylor, Ramasamy, & Richards, 1999). PND is a method used to calculate the number or non-overlap between baseline and intervention phases in order to supplement visual inspection of single subject research designs (Parker & Vannest, 2009; Scruggs, Mastropieri, & Castro, 1987).

For on-task behaviour, PND was calculated by identifying the highest data point in baseline and determining the total number of data points in intervention conditions that exceeded this point. For out of seat behaviour, PND was calculated by identifying the lowest data point in baseline and determining the total number of data points in intervention conditions that were below this point. The number of non-overlapping data points was divided by the total number of data points in the intervention condition and multiplied by 100. PND scores range from 0% to 100% with higher scores indicating a more successful intervention. Scruggs, Mastropieri, Cook, and Escobar (1986) outlined specific criteria for interpreting PND such that a percentage greater than 90% is highly effective, 70% to 90% fairly effective, 50% to 70% questionable effectiveness, and less than 50% reflects unreliable treatment.

Social Validity

At the conclusion of the study, the participants completed the *Kids Intervention Profile* (KIP; Eckert, Coddling, Hier, Sullivan, & Malandrino, 2014; 2017). The KIP is an 8-item questionnaire that assesses the acceptability of the intervention and perceived impact on student skills (see Appendix I). Items are rated using boxes that gradually increase in size to correspond to their preference ranging from *not at all* to *very, very much*. In other words, consistently small boxes indicate disagreement with the intervention while frequent selection of large boxes indicates stronger acceptance. These boxes were quantified so that individual item scores ranged from 1 being *not at all* (i.e., smallest box) to 5 being *very, very much* (i.e., largest box). The wording on this measure was slightly modified to reflect its use with stability balls as the intervention.

Results

Results of classwide direct observation of out-of-seat behaviour and on-task are presented in Figure 1 and Figure 2. This indicates the percent of 10-second intervals in which the targeted behaviours were observed during baseline and sensory ball conditions.

Sensory balls demonstrated a decrease in out-of-seat behaviour from a mean of 4.17% of intervals during initial baseline to a mean of 2.52% during the first intervention. During return to second baseline, out-of-seat behaviour increase to a mean of 3.4 % of intervals and return to intervention produced a decrease to 2.2 % of intervals. A series of five consecutive observation post intervention (maintenance phase) shows a slight increase in out of seat behaviour with a mean of 2.3%

Out of Seat Behaviour

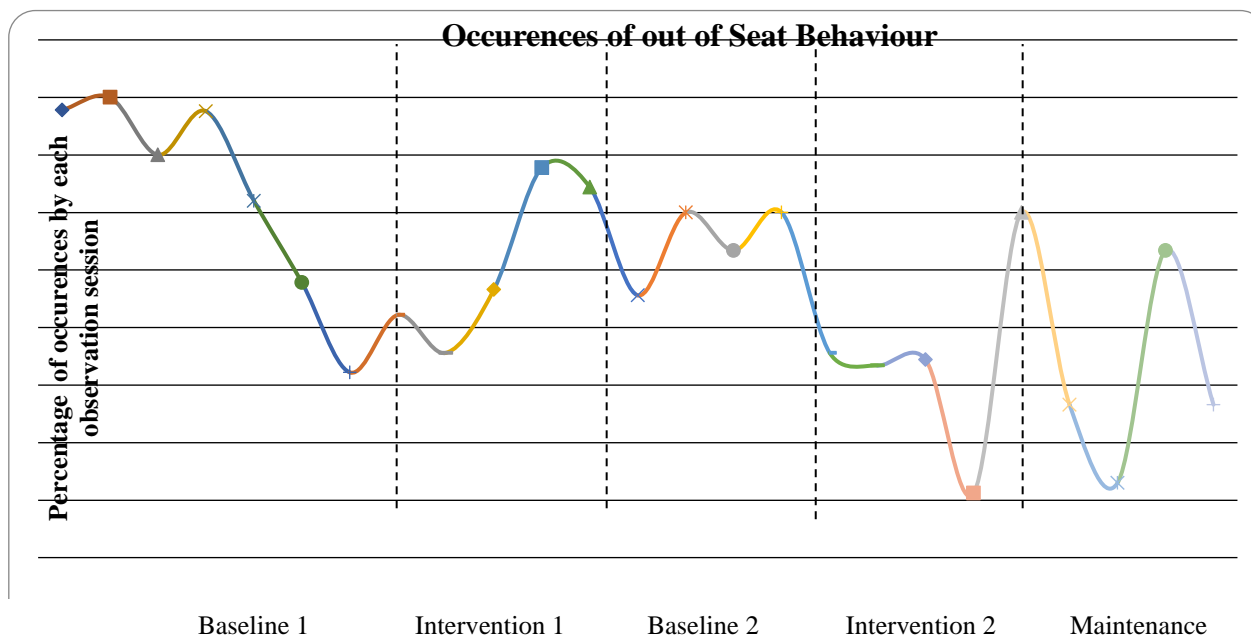


Figure1. Diagrams the mean of occurrences in which out of seat behaviour have been observed classwide during baseline and intervention session with sensory ball condition.

Baseline phases produced an overall range of targeted behaviour from 3.10 % to 4.39 % of intervals. In comparison, intervention phases resulted in out-of-seat behaviour ranging from 1.10% to 3.50%. Within each phase, out-of-seat behaviour was variable. During initial baseline, out-of-seat behaviour ranged from 0.15% to 0.78%. Out-of-seat behaviour during initial intervention conditions were similar to baseline phase ranged from 0.16 % to 0.79% of intervals. Return to baseline 2 demonstrated less behaviour than initial baseline, ranging from 0.20% to 1.10 % of intervals while return to intervention 2 phases ranged from 0.49% to 2.44 %. In addition, maintenance phase resulted in out of seat behaviour ranging from 0.45% to 2.35 %. Table 1 includes the range and means for each phase and overall phases for out-of-seat behaviour.

Table 1. Phase Means, Overall Means, and Overall Range of Observed Out of Seat Behaviour

Phases	Phase M					Overall M		Overall Range		
	B1	I1	B2	I2	M	B	I	B	I	M
Out of Seat	4.17	2.52	3.4	2.2	2.3	3.79	2.40	2.11- 4.39	1.06-3.5	1.15-3.5

Note: B1 denotes Baseline phase 1 (standard classroom chairs), I1 denotes intervention phase 1 (sensory ball intervention), B2 denotes baseline phase 2 (standard classrooms chairs), I2 denotes intervention phase 2 and M denotes Maintenance phase

On Task Behaviour

During the first baseline phase, student demonstrated a mean of 40.0 % in which they were on task. After implementing sensory balls, on-task behaviour increased to go % during the intervention phase. Returning to second baseline phase, on-task behaviour once again decreased to a mean of 47.1 % of intervals. The second intervention phase displayed a slight increase in on-task behaviour to a mean of 59.1% of intervals. While students' on task behaviour during the maintenance phase gradually increase to 61.0%. Baseline phases produced an overall range of on-task behaviour from 33.3% to 54.4% (M=43.75%). Sensory ball phases produced an overall range of on-task behaviours from 53.3% to 67.8% of intervals (M=60.55%)

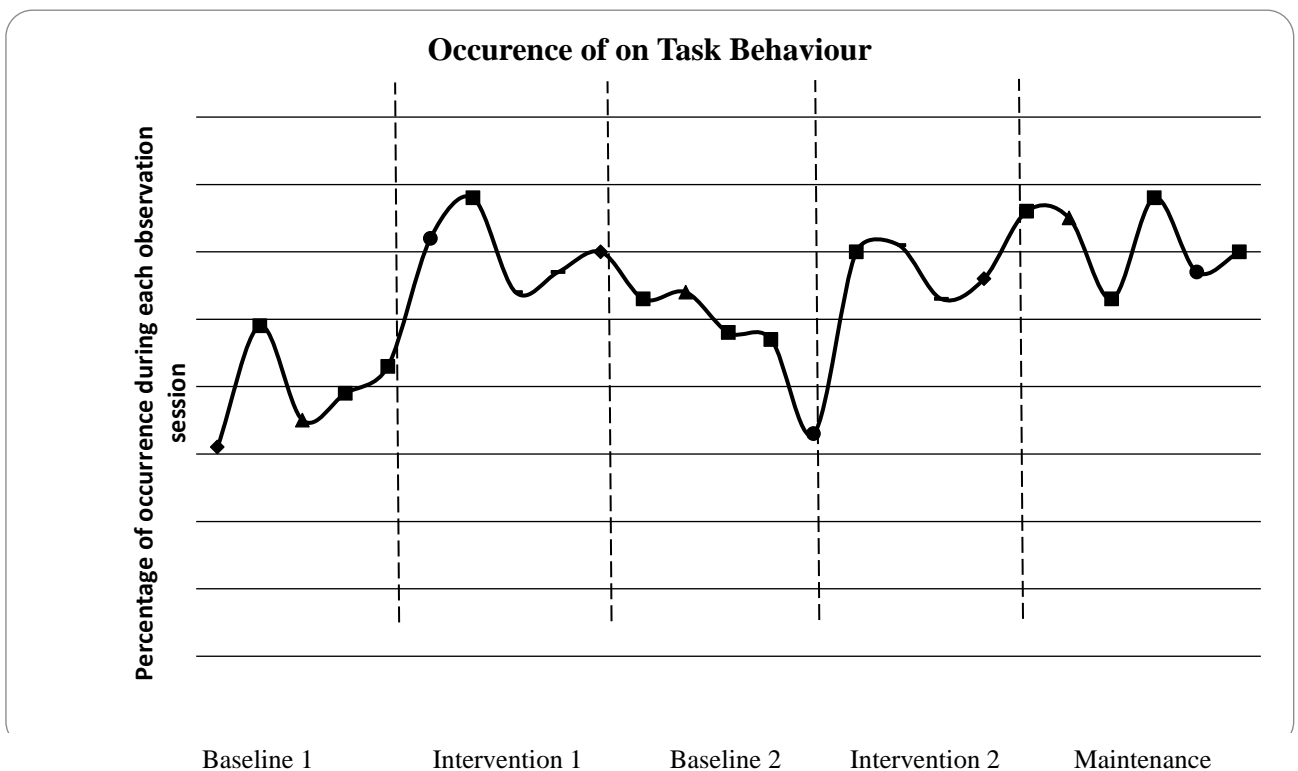


Figure 2. Diagrams the mean of occurrences in which on task behaviour have been observed classwide during baseline and intervention session with sensory ball condition.

These results indicate that sensory balls demonstrated higher overall on-task behaviour in comparison to baseline with a satisfying increase. In addition, on-task behaviour was more variable during intervention. Table 4.2 includes the range and means for each phase and overall phases.

Table 2. Phase Means, Overall Means, and Overall Range of Observed on Task Behaviour

Phases	Phase M					Overall M		Overall Range		
	B1	I1	B2	I2	M	B	I	B	I	M
Out of Seat	40.4	60.0	47.1	59.1	61.0	43.70	59.55	33.3- 55.33	53.3- 67.8	53.3- 65.0

Note: B1 denotes Baseline phase 1 (standard classroom chairs), I1 denotes intervention phase 1 (sensory ball intervention), B2 denotes baseline phase 2 (standard classrooms chairs), I2 denotes intervention phase 2 and M denotes Maintenance phase.

Writing Productivity

Classwide academic productivity of written expression is presented in Figure 3. This indicates the total words written on average during baseline and intervention conditions. For classwide academic productivity, sensory balls produced an increase in writing accuracy from a mean $M=$

14 total words written during initial baseline to a mean of $M=63$ total words written during initial intervention phase.

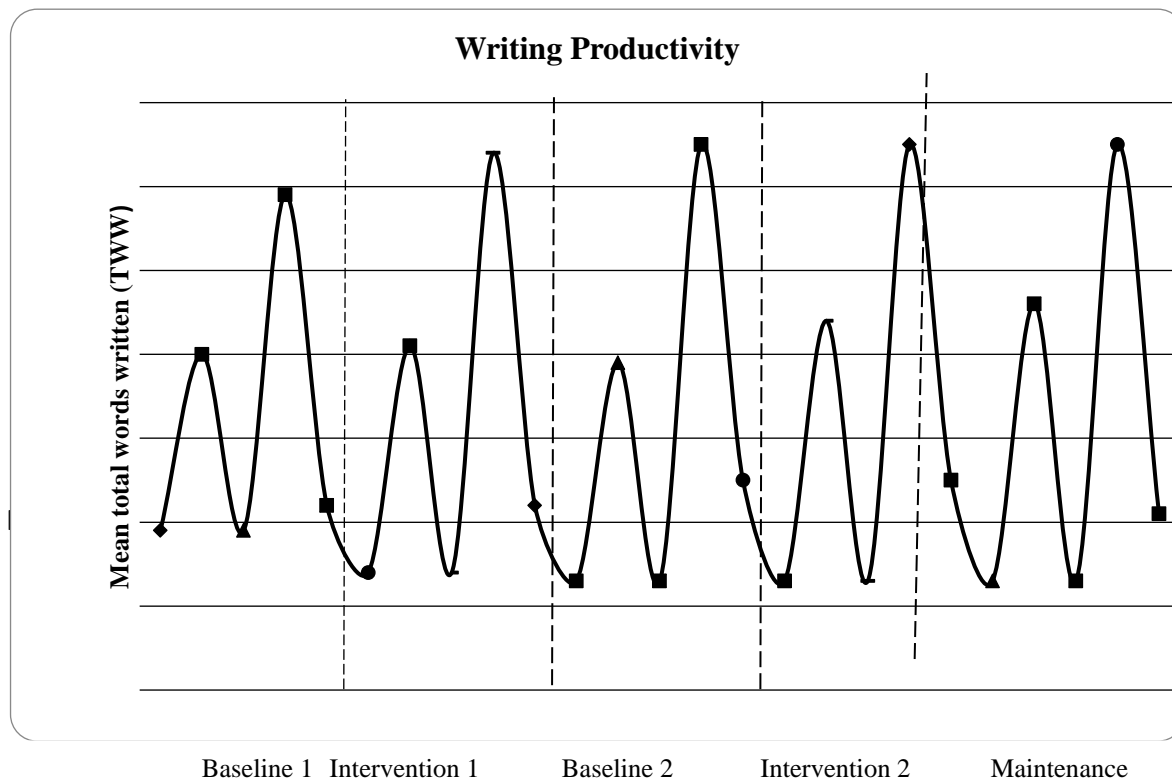


Figure3. Diagrams the mean total words written (TWW) classwide during baseline, intervention and maintenance conditions.

Mean writing accuracy during the baseline phase 2 however remained the same when compared with baseline phase 1 with an average $M = 14$ total words written. However mean writing accuracy during intervention phase 2 were $M = 42$ total words written. The results demonstrate that sensory balls were as effective as chairs at the classwide level due to the amount of overlapping data points across conditions. That is, the percentage of non overlapping data points during initial baseline and intervention phases was 80%, although all data were overlapping within return to baseline and return to sensory ball phases. However, it is important to note that students wrote a mean of $M=23$ words accurately during the maintenance phase at the conclusion of the study. In other words, students wrote an average of 10 words more after 15 weeks in comparison to baseline.

Social Validity

All students were administered the Kids Intervention Profile (KIP) to obtain an estimate of intervention acceptability. Based on the classwide ratings on the KIP, students reported that they enjoyed sensory balls very much at many times ($M = 2.6$) and liked sitting on them a lot of times ($M = 4.2$). Students sometimes wanted to stop sitting on the sensory balls ($M = 3.73$). It is also seen that students do not prefer sitting on sensory balls just for several times ($M = 1.6$) and do not prefer not sitting on sensory ball at all ($M = 1.3$) while working. A mean item score of $M = 2.72$

out of 5 was obtained on the KIP indicating that students reported medium high acceptability of the sensory balls in the special education classroom.

Discussion

It was hypothesized that students would be on-task more and out-of-seat less while seated on sensory balls in comparison to classroom chairs. Based on the results of this study, these hypotheses were supported. Sensory balls did not show marked improvement over intervention phases for on-task and on seat behaviours. These results may have been impacted by a ceiling effect for on-task behaviour that limited a clear distinction between chairs and sensory balls. In other words, class wide on-task behaviour was an average of 43.75% of intervals during initial baseline which limited the opportunity for improvement in overall on-task behaviour. However out-of-seat behaviour did improve while students were seated on sensory balls in comparison to classroom chairs.

Similarly to on-task behaviour, class wide out-of-seat behaviour may have been impacted by a floor effect that limited the opportunity for improvement in overall behaviour. That is, class wide behaviour of out-of-seat behaviour was an average of 3.4% of intervals during baseline phase and did not exceed 3.5% of intervals over the course of the study. There was greater variability during initial conditions, and these effects were replicated during return to sensory balls. For this study, observation of individual student behaviour was aggregated to represent class wide behaviour. However, teacher ratings represent an accumulation of student behaviour overall.

Thus, there is a possibility that percent occurrence of direct observation underestimated the behaviours observed by the teacher class wide. It is also likely that these data were affected by the teacher's preference for sensory balls prior to participation in this study.

For writing productivity, it was hypothesized that students would increase their writing fluency while seated on sensory balls in comparison to classroom chairs. Results did show great improvement in writing fluency at the class wide level, yet writing fluency while seated on sensory balls was similar to classroom chairs. After a few sessions TWW increased while students in all the phases and plunge. However, these results were not replicated across return to baseline and sensory balls conditions.

Practice effects may have impacted writing performance, as the class had not completed Kurikulum Standard Sekolah Rendah Pendidikan Khas writing probes prior to their participation in this study. Despite limited gains observed through visual analysis, there were gains in the average total words written class wide from initial baseline (TWW= 5) to sensory balls (TWW=18). While during the maintenance phase students TWW were 23. This indicates that students wrote 10 more words on average over the course of the study (15 weeks).

Although sensory balls did not demonstrate marked improvement, writing fluency increased overall indicating that sensory balls are similarly effective in comparison to classroom chairs. Strengths of this study were strong reliability of direct observation and procedural integrity of

writing sessions. These reliability estimates reflect the constancy of the observation method such that changes in these data can be attributed to changes in targeted behaviour as opposed to the method itself (Hartmann, 1977). These results indicate that direct observation, scoring of TWW, and administration of writing prompts was consistent throughout the course of the study. Thus, results of this study were documented as intended.

The students reported high acceptability of sensory balls in the classroom. Overall, students enjoyed sitting on sensory balls and wished they had more opportunities to sit on them at times. These findings indicate that most students attribute sensory balls as an impactful intervention for improving their behaviour. Although students were not specifically asked to compare their performance while seated on sensory balls to classroom chairs, it is noteworthy that student report does not coincide with direct observation of behaviour.

Student behaviour was only observed during a 20-minute session twice per week. Thus, students' perceptions regarding the sensory balls have occurred beyond the observation period as reported on the KIP. Student writing was only measured using a 3-minute writing probe as opposed to academic outcomes in other areas. This may account for the discrepancy between student ratings and writing performance. Again, these findings indicate that most students consider sensory balls as an effective modality for improving their writing performance and the observed performance supports these claims overall. These results also suggest that student interpretation of the effects of sensory balls may be related to individual performance as opposed to class wide outcomes.

Few studies have investigated sensory balls as a classroom intervention. Results of the first studies conducted by Illi (1994) and Witt and Talbot (1998) found that sensory balls were not only beneficial for student back-health, but also indicated positive improvement in sustaining attention, in-seat behaviours, and academic performance. However, these outcomes were not measured directly and only documented anecdotally.

The findings of this study supports extensively proponents (Mead et al, 2016; Sadr et al, 2017 & Schilling and colleagues, 2003) who systematically examine the effectiveness of sensory balls using 10-second momentary time sampling of student in seat behaviour and legible words written. Additionally, Schilling and Schwartz (2004) measured student engagement and in-seat behaviour using 10-second momentary time sampling. Conversely, Bagatell et al, (2010) investigated the use of sensory balls using video recordings to document the duration of student engagement and out-of seat behaviour, while Fedewa and Erwin (2011) used 30-second momentary time sampling of in-seat and on-task behaviour. Each of these studies used informal social validity questionnaires to document treatment acceptability from educators and students.

The existing literature has primarily investigated the effects of sensory balls with students with disabilities. These studies have been conducted within various settings (preschool, elementary, college) and utilized various research designs and outcome measures to document effectiveness. In addition, previous research has been implemented with individual students, some of which have been seated on sensory balls only during the duration of the observation

period (e.g., Schilling & Schwartz, 2004), or class wide without documenting class wide outcomes (e.g., Fedewa & Erwin, 2011). Despite their increasing popularity as a class wide intervention, there are currently no published studies reporting the effectiveness of sensory balls at this level.

While the current study extends previous research of sensory balls among students with learning disabilities, it also represents the first study investigating the intervention at the class wide level (Ahmann, Saviet, & Tuttle, 2017; Wood, Klebanoff, , Renno, Fujii, & Danial, 2017). Additionally, this was the first study to utilize various methods with multiple dependent measures to investigate their effects. That is, this study demonstrated the similar effects (Gaston, Moore & Butler, 2016; Mead, Scibora, Gardner, & Dunn, 2016) of sensory balls in comparison to classroom chairs using direct observation of student on-task and out-of-seat behaviour, academic productivity in a special education classroom as well acquiring students' feedback regarding their experiences while engaged with sensory ball seating instead of chair during the intervention phases. Using an A-B-A-B reversal design, this study sought to investigate if sensory balls improved class wide student behaviour in comparison to classroom chairs, and whether or not sensory balls showed an increase in student writing fluency. In addition, the study examined student acceptability of sensory balls at a class wide level using standardized assessment methods.

Implications

The results of the current study indicate that sensory balls produce positive results in terms of class wide behaviour in comparison to classroom chairs. Some improvements were shown for writing fluency over the course of the study, however it is necessary to consider the feasibility of the implementation of sensory balls in order to demonstrate greater gains in overall performance.

Overall, sensory balls did demonstrate substantial improvements on behaviour and writing productivity of students with learning disabilities. Therefore, continued research investigating sensory balls at the class wide level is needed to determine whether or not the effects of sensory balls on student performance outweigh traditional seating. It is also expected this study will offer more researches conducted targeting on sensory-motor activities to expand the relationship between the use sensory integration materials in special need classroom and its outcome on the students functioning and development.

Limitations

Only one classroom with 8 students participated in this study and were selected based on their special need traits as learning disabled. In comparison to typical classrooms, this class size is rather small. Granted this classroom had a greater number of students in comparison to those targeted in previous studies, the addition of 5 or more students in the classroom may have demonstrated substantial differences in outcomes.

Additionally, student behaviour and academic productivity were only assessed during a writing lesson for each session. Therefore, future researchers should evaluate the effects of sensory balls with classrooms that have yet to implement sensory balls in comparison to those that have used them previously. More classrooms should also be evaluated simultaneously

including a control classroom to document effectiveness. A comparison of classrooms that have no experience implementing sensory balls may demonstrate dissimilar outcomes.

Documenting these effects across multiple instructional periods and activities may also prove beneficial and allow for investigation of generalization across settings. Occasionally, the students were hyper active and exhibit tantrums during the study which limited the opportunity for improvements in behaviour. That is, student on-task behaviour occurred with overall range of 53.3 to 68.75% of intervals and out-of-seat overall range occurred at 1.06 to 3.5% of intervals over the course of the study.

Selection of classrooms that have lower rates of on-task and higher rates of out-of-seat behaviour may allow for greater distinction between chairs and sensory balls, thus lessening the impact of ceiling and floor effects on student behaviour. Although the purpose of the study was to examine the class wide effects of sensory balls, another limitation is that individual data were not collected. Results were comparable to classroom chairs only with greater variability in behaviour. Due to the class wide behavioural observations, it is impossible to differentiate students who responded to the class wide use of sensory balls in comparison to others.

Future Research

Future research should consider implementing sensory balls class wide with target students and including a control classroom to compare effects. Furthermore, writing fluency was also examined at the class wide level by reporting a mean of total words written across students. Subsequent research is needed to examine both class wide and individual student writing fluency and other academic areas to determine the appropriateness of sensory balls as a support to academic performance.

Lastly, educators should consider the cost-benefit of sensory balls as a classroom intervention in comparison to classroom chairs prior to implementation. Olson and colleagues (2014) found that lack of resources was the greatest barrier to implementation for those interested in using sensory balls in their classroom (67%), followed by concern for misuse by students (24%), concern for personal distraction (5.6%), and lack of support (3.7%). In order to justify allocating limited resources to this alternative to classroom seating, documentation of clear benefits is still needed prior to implementation.

Also, research could be done using an additional assessment tool to gain more understanding of the different areas of handwriting that could be impacted. Researchers might also consider exploring if using ball chairs impacts time-on-task behaviours and movement of students. Ball chairs have been used as a positive teaching tool in many classrooms, and more research may help teachers to understand how the balls may be beneficial in their classrooms.

Conclusion

The purpose of this study was to determine if using a sensory ball instead of a classroom chair in a special education classroom would improve students' behaviour and handwriting. The comparative researches help to recognize different aspects of features of alternative seating

devices that are more suitable for students with learning disabilities. With regards to thousands of students with special difficulty in sitting and classroom performance, these devices may be an optional selection for solving class behaviour problems and their academic executive functions.

Acknowledgement

Principals, teacher and Students of SK Seri Aman (Special Education Integrated Programme) Perak Education Department (JPN Perak).

Corresponding Author

Grace Annammal Piragasam, Department of Special Education, Malaysia.grace@fpm.upsi.edu.my. Sultan Idris Education University.

References

- Ahmann, E., Saviet, M., & Tuttle, L. J. (2017). Interventions for ADHD in Children And Teens: A Focus on ADHD Coaching. *Pediatric Nursing*, 43(3), 121.
- Al-Eisa, E., Buragadda, S., & Melam, G. R. (2013). Effect of Therapy Ball Seating on Learning and Sitting Discomforts among Saudi Female Students. *BioMed Research International*, 2013, 153165. <http://doi.org/10.1155/2013/153165>.
- Bagatell, N., Mirigliani, G., Patterson, C., Reyes, Y., & Test, L. (2010). Effectiveness of therapy ball chairs on classroom participation in children with autism spectrum disorders. *American Journal of Occupational Therapy*, 64(6), 895-903.
- Bagatell, N., Mirigliani, G., Patterson, C., Reyes, Y., & Test, L. (2010). Effectiveness of therapy ball chairs on classroom participation in children with autism spectrum disorders. *American Journal of Occupational Therapy*, 64(6), 895-903.
- Barlow, D. H., & Hersen, M. (1984). Single case experimental designs: Strategies for studying behavior change (2nd ed.). Needham Heights, MA: Allyn & Bacon.
- Barrish, H. H., Saunders, M., & Wolf, M. M. (1996). Good Behavior Game: Effects of individual contingencies for group consequences on disruptive behavior in a classroom. *Journal of Applied Behavior Analysis*, 2, 119-124.
- Berninger, V., Abbott, R., Cook, C. R., & Nagy, W. (2017). Relationships of attention and executive functions to oral language, reading, and writing skills and systems in middle childhood and early adolescence. *Journal of learning disabilities*, 50(4), 434-449.
- Bill, V. N. (2008). *Effects of stability balls on behavior and achievement in the special education classroom*. Southwest Minnesota State University. Retrieved December 2016.
- Boone, N. (2016). *On the Move: A Mixed-Methods Study to Examine the Impact of Kinesthetic Learning Tables on Student On-Task Behavior and Academic Growth*. Gardner-Webb University.
- Buku Data Pendidikan Khas. (2016) <https://moe.gov.my/images/KPM/BPKhas/buku-data-pendidikan-khas-2016-PRINT.pdf>. Retrieved February 2017.
- Case-Smith, J., Weaver, L. L., & Fristad, M. A. (2015). A systematic review of sensory processing interventions for children with autism spectrum disorders. *Autism*, 19(2), 133-148.
- Chafouleas, S. M. (2011). Direct behavior rating: A review of the issues and research in its development. *Education and Treatment of Children*, 34, 574-591.

- Coffin, A. B., Myles, B. S., Rogers, J., & Szakacs, W. (2016). Supporting the Writing Skills of Individuals with Autism Spectrum Disorder Through Assistive Technologies. In *Technology and the Treatment of Children with Autism Spectrum Disorder* (pp. 59-73). Springer International Publishing.
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River, NJ: Pearson Education.
- Croft, C. (2016). *Caring for Young Children with Special Needs*. Redleaf Press.
- DiBitetto, S. L. (2015). *An Examination of Exercise Balls Used as Chairs and the Impact on Student Achievement Growth among General Education Sixth-Grade Math Students in a Select Middle School in Northern Illinois*. Aurora University.
- Eckert, T. L., Coddling, R. S., Hier, B. O., Sullivan, W., & Malandrino, R. (2014). Assessing children's perceptions of academic interventions: The Kids Intervention Profile. Manuscript in preparation. Department of Psychology, Syracuse University, Syracuse, NY.
- Eckert, T. L., Hier, B. O., Hamsho, N. F., & Malandrino, R. D. (2017). Assessing children's perceptions of academic interventions: The Kids Intervention Profile. *School Psychology Quarterly*, 32(2), 268.
- Feder, K. P., & Majnemer, A. (2007). Handwriting development, competency, and intervention. *Developmental Medicine & Child Neurology*, 49(4), 312-317.
- Fedwa, A. L., & Erwin, H. E. (2011). Stability balls and students with attention and hyperactivity concerns: Implications for on-task and in-seat behavior. *American Journal of Occupational Therapy*, 65(4), 393-399.
- Nicpon, F. M., Allmon, A., Sieck, B., & Stinson, R. D. (2011). Empirical investigation of twice-exceptionality: Where have we been and where are we going?. *Gifted Child Quarterly*, 55(1), 3-17.
- Gaston, A., Moore, S., & Butler, L. (2016). Sitting on a stability ball improves attention span and reduces anxious/depressive symptomatology among grade 2 students: A prospective case-control field experiment. *International Journal of Educational Research*, 77, 136-142.
- Greene, D. P., & Roberts, S. L. (2015). *Kinesiology-E-Book: Movement in the Context of Activity*. Elsevier Health Sciences.
- Gresham, F. M. (2016). Social skills assessment and intervention for children and youth. *Cambridge Journal of Education*, 46(3), 319-332.
- Hartmann, D. P. (1977). Considerations in the choice of interobserver reliability estimates. *Journal of Applied Behavior Analysis*, 10, 103-116.
- Hosp, J. L., Ford, J. W., Huddle, S. M., & Hensley, K. K. (2017). The Importance of Replication in Measurement Research: Using Curriculum-Based Measures With Postsecondary Students With Developmental Disabilities. *Assessment for Effective Intervention*, 1534508417727489.
- Hosp, M. K., Hosp, J. L., & Howell, K.W. (2007). *The ABCs of CBM: A practical guide to curriculum-based measurement*. New York, NY: Guilford Press.
- Illi, U. (1994). Balls instead of chairs in the classroom? *Swiss Journal of Physical Education*, 6, 37-39.
- Jung, P. G., McMaster, K. L., & delMas, R. C. (2017). Effects of Early Writing Intervention Delivered Within a Data-Based Instruction Framework. *Exceptional Children*, 83(3), 281-297.

- Kafka, N., & Limberg, R. (2013). Surveying Teachers about the Use of Stability Balls as an Intervention. *Journal of Undergraduate Research at Minnesota State University, Mankato*, 13(1), 3.
- Kennedy, C. (2005). *Single case designs for educational research*. Boston: Allyn & Bacon.
- Kilbourne, J. (2009). Sharpening the mind through movement: Using exercise balls as chairs in a university class. *Chronicle of Kinesiology and Physical Education in Higher Education*, 20, 10-15.
- King, B., Radley, K. C., Jenson, W. R., & O'Neill, R. E. (2017). On-Task in a Box: An evaluation of a package-ready intervention for increasing levels of on-task behavior and academic performance. *School Psychology Quarterly*, 32(3), 306.
- Kurikulum Standard Sekolah Rendah Pendidikan Khas Masalah Pembelajaran (KSSR PK). <https://sites.google.com/site/kssrppki/>. Retrieved Januari 2017.
- Linksman, R. (1998). The fine line between ADHD and Kinesthetic Learners. Retrieved May 16, 2017.
- Livingstone, R., & Paleg, G. (2014). Practice considerations for the introduction and use of power mobility for children. *Developmental Medicine & Child Neurology*, 56(3), 210-221.
- Marr, D., Cermak, S., Cohn, E. S., & Henderson, A. (2003). Fine motor activities in Head Start and kindergarten classrooms. *American Journal of Occupational Therapy*, 57(5), 550-557.
- Sadr, M. N., Haghgoo, H. A., Samadl, S. A., Rassafiani, M., Bakhshi, E., & Hassanabadi, H. (2017). The Impact of Dynamic Seating on Classroom Behavior of Students with Autism Spectrum Disorder. *Iranian Journal of Child Neurology*, 11(1), 29-36.
- McHale, K., & Cermak, S. A. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy*, 46(10), 898-903.
- Mead, T., Scibora, L., Gardner, J., & Dunn, S. (2016). The Impact of Stability Balls, Activity Breaks, and a Sedentary Classroom on Standardized Math Scores. *Physical Educator*, 73(3), 433.
- Medland, M. B., & Stanchnik, T. J. (1972). Good Behavior Game: A replication and systematic analysis. *Journal of Applied Behavior Analysis*, 5, 45-51.
- Michiels, B., Heyvaert, M., Meulders, A., & Onghena, P. (2017). Confidence intervals for single-case effect size measures based on randomization test inversion. *Behavior research methods*, 49(1), 363-381.
- Molitor, S. J., Langberg, J. M., Bourchtein, E., Eddy, L. D., Dvorsky, M. R., & Evans, S. W. (2016). Writing abilities longitudinally predict academic outcomes of adolescents with ADHD. *School Psychology Quarterly*, 31(3), 393.
- MyHEALTH Portal. (2017) <http://www.myhealth.gov.my/en/>
- Olson, N. A., Lamminen, R. J., & Panahon, C. J. (2014, January). Investigating the use of stability balls in the classroom. <https://cornerstone.lib.mnsu.edu/cgi/viewcontent.cgi?article=1395&context=etds>. Retrieved march 2017.
- Pagliano, P. (2017). *Multisensory environments*. Routledge.
- Parker, R. I., & Vannest, K. J. (2009). An improved effect size for single case research: Nonoverlap of All Pairs (NAP). *Behavior Therapy*, 40, 357-367.

- Re, A. M., Lovero, F., Cornoldi, C., & Passolunghi, M. C. (2016). Difficulties of children with ADHD symptoms in solving mathematical problems when information must be updated. *Research in developmental disabilities, 59*, 186-193.
- Regan, K., Mastropieri, M., & Scruggs, T. (2005). Promoting expressive writing among students with emotional and behavioral disturbance via dialogue journals. *Behavioral Disorders, 31*, 33-50.
- Richards, S. B., Taylor, R. L., Ramasamy, R., & Richards, R. Y. (1999). Single subject research. *San Diego, CA: Singular*.
- Rock, M. L., Spooner, F., Nagro, S., Vasquez, E., Dunn, C., Leko, M., ... & Jones, J. L. (2016). 21st century change drivers: Considerations for constructing transformative models of special education teacher development. *Teacher Education and Special Education, 39*(2), 98-120.
- Rubin, A., & Babbie, E. R. (2016). *Empowerment series: Research methods for social work*. Cengage Learning.
- Schilling, D. L., & Schwartz, I. S. (2004). Alternative seating for young children with autism spectrum disorder: Effects on classroom behavior. *Journal of Autism and Developmental Disorders, 34*(4), 423-432.
- Schilling, D. L., Washington, K., Billingsley, F. F., & Deitz, J. (2003). Classroom seating for children with attention deficit hyperactivity disorder: Therapy balls versus chairs. *American Journal of Occupational Therapy, 57*(5), 534-541.
- Scruggs, T. E., Mastropieri, M. A., & Castro, G. (1987). The quantitative synthesis of single-subject research: Methodology and validation. *Remediate and Special Education, 8* 24-33.
- Scruggs, T. E., Mastropieri, M. A., Cook, S. B., & Escobar, C. (1986). Early intervention for children with conduct disorders: A quantitative synthesis of single-subject research. *Behavioral Disorders, 11*, 260-271.
- Suen, H. K., & Ary, D. (2014). *Analyzing quantitative behavioral observation data*. Psychology Press. Retrieved December 2016.
- Sugden, D. A., & Wright, H. C. (2013). *Physical Education for All: Developing Physical Education in the Curriculum for Pupils with Special Difficulties*. Routledge.
- Valentini, N. C., Pierosan, L., Rudisill, M. E., & Hastie, P. A. (2017). Mastery and exercise play interventions: motor skill development and verbal recall of children with and without disabilities. *Physical Education and Sport Pedagogy, 22*(4), 349-363.
- Wagner, D. L., Hammerschmidt-Snidarich, S. M., Espin, C. A., Seifert, K., & McMaster, K. L. (2017). Pre-service Teachers' Interpretation of CBM Progress Monitoring Data. *Learning Disabilities Research & Practice, 32*(1), 22-31.
- Wang, M., & Reid, D. (2011). Virtual reality in pediatric neurorehabilitation: attention deficit hyperactivity disorder, autism and cerebral palsy. *Neuroepidemiology, 36*(1), 2-18.
- Witt, D., & Talbot, R. (1998). Let's get our kids on the ball. *Advance for Physical Therapists, 27-28*.
- Wood, J. J., Klebanoff, S., Renno, P., Fujii, C., & Danial, J. (2017). Individual CBT for Anxiety and Related Symptoms in Children With Autism Spectrum Disorders. *Anxiety in Children and Adolescents with Autism Spectrum Disorder: Evidence-Based Assessment and Treatment, 123*.