# THE IMPACT ON INDEPENDENT WORK COMPLETION AND ACCURACY USING THE WOBBLE STOOL AS ACTIVE SEATING

A Dissertation

Presented to

The Faculty of the Education Department

Carson-Newman University

In Partial Fulfillment

Of the

Requirements for the Degree

Doctor of Education

By

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April 2018

CARSON-NEWMAN
UNIVERSITY

Dissertation Approval

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Dissertation Title: THE IMPACT ON INDEPENDENT WORK COMPLETION AND ACCURACY USING THE WOBBLE STOOL AS ACTIVE SEATING

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## Abstract

The purpose of this quantitative study was to examine the effects of using flexible, active seating on student academic outcomes. Students used wobble stools and regular classroom chairs in their classrooms. Daily student work products completed while seated on the wobble stool, and those completed while using standard classroom chairs were compared. Both work accuracy and total work completed were measured for each work sample. The population sampled included 13 students comprised of both public and private school elementary students in grades 1 – 5. A total of 108 daily independent work samples were collected over a two-week time period. Half the samples were completed while students used flexible seating. The other half of the work samples were completed while students sat in standard classroom chairs. Based on data collected, there was an overall improvement in both work completed and work completed accurately while using the wobble stool. The results from the work samples failed to reach clinical significance at the .05 alpha level for both accuracy ($p=.14$) and total work completed ($p=.15$). When divided by gender, the results approached the critical alpha level for female subjects for work accuracy, $p = .06$. Male subjects exceeded the .05 critical alpha level for amount of work completed, $p = .04$; thereby rejecting the null hypothesis for that condition. Results suggest benefit of active seating using the wobble stool on daily work completion.



**Key Words:** ***wobble stool, active seating, classroom environment, flexible seating***

**Acknowledgements**

I would like to acknowledge my dissertation committee, without whose support and encouragement this goal would not have been reached. Dr. Deborah Hayes has been a steadfast cheerleader and encourager throughout the doctoral program. She was unwavering in her support of me and this project. As my chair, she guided me, and helped me arrive at a product that I know would make her proud. Her untimely passing prevented her seeing this final product. Her encouragement and high expectations helped get this project up and running. May her spirit live on through those whose lives she touched.

Dr. Patricia Murphree stepped in at the eleventh hour as my new chair to see me through to the end of this project at a critical time in the process. Throughout the course of this program Dr. Murphree has challenged me to move beyond what I know already. She has been patient and steadfast through to the completion of this project. Thank you, Dr. Murphree for your willingness to take this on, and for getting me through to the finish line. I would like to thank Dr. P. Mark Taylor for his "no nonsense" approach to methodology. He was instrumental in the early planning for this project. Dr. Taylor provided guidance and direction through the analysis and final stages. His sense of humor and his realistic approach kept things light and moving forward.

Next, I would like to acknowledge the support of a respected colleague, and dear friend, Dr. Beverly Whalen-Schmeller, who joined this committee as content expert. Dr. Whalen's excitement for this project, coupled with her vision and experience, played a large role in the development of this study. She has been a sounding board, a consultant for all the special circumstances, and an expert wordsmith. Dr. Whalen gave me encouragement me when the chips have been down and made me laugh more times than I can count. She tirelessly read and corrected my writing. She is a genius, and I am honored she agreed to be part of this journey.

I would like to thank my family who have cheered me on every step of the way. My mother, my brothers, my cousins, my nieces and nephews, and my in-laws have all encouraged me to follow this dream. Moreover, my husband and children have given their support, encouragement, and cooperation. Balancing family, work, and graduate school forced our family to re-align our focus on time we have together, and to prioritize. I could not have accomplished this goal without my husband. He is my partner in this wild life and has encouraged me through this entire graduate school journey. I love you all!

I truly rely on the support of my family and friends. I am lucky that I am surrounded by so many people who want to see me succeed. These people are my ride or die friends. They are the ones who will see you to the end and pull you across the finish line if that's what it takes. Thank you to my oldest friends first: Claire, Juli, Jill, Scarlett, Mistie, Jenny, Lori. There is something magical about having your oldest friends believe in you – even if they think you are out of your mind for going back to school again. Thank you for the special messages, calls, texts, and distractions along the way. Thank you to my Nashville squad: DeVolla, Brooke, Erica, Bev, and Susan. I cannot thank you all enough. Your support cannot be measured. You are all passionate, kind, and brilliant. I am lucky to have you in my life. I appreciate all the ways you make a difference in this world, and especially the difference you make to me. I could not have survived this program without my two newest friends, Dr. Misty Hance and Dr. Latoya Combs. These women are fierce, and smart, and talented. We have run alongside one another for the last three years on this journey. Your help and support have seen me through. I am so proud of us!

I would like to thank my mentor, Dr. Lisa Bilton, who has given me opportunities to learn and grow as a leader within the Department of School Psychology, and in the larger

Department of Special Education. Dr. Bilton has provided me with insight into the unique tasks and challenges facing leaders in large, urban districts. She has encouraged me to expand my skills and to follow my own path.

This project would not have been possible at all without the participation of the schools and the teacher volunteers. I would like to say a special thank you to Dr. BJ Wiener of Kirk Day School. She was an amazing gift at the right time thanks be to God! I would also like to thank Hamblen County schools for participating in this study. The teachers who collected data for this study deserve special recognition for getting it done so quickly and with such joyful attitudes. Special thank you to Dr. Misty Hance, again, for helping identify teachers to participate in this study. Thank you to Dr. Chris Coffey for consulting on statistical matters.

Finally, I would like to thank God. Without Him, this entire journey would have been impossible. There have been blessings, and lessons, and things that could not have worked out if it were not by His will. I have no doubt that God heard the prayers of my friends and family during graduate school.

## Dedication

I would like to dedicate this dissertation to my family. You are my everything. I love each of you more than you realize. Thank you for all the things you have done to help me realize this dream. This is a win for us all!

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# Chapter 1 Purpose and Organization

## Background of the Study

In this era of education, there are trends toward changing the classroom environment (Merrill, 2017). Trends include ideas like the flipped classroom and flexible seating. At the same time that these trends have developed, school demands have risen for children with the adoption of new standards like Common Core. What was once thought to be age-appropriate curriculum and educational experience for the earliest grades has now changed to require skills previously expected a year or more later in the typical curriculum. Students have more rigorous demands on their time, and these demands are devoted to tasks that require a lot of sitting.

In classrooms across the country teachers are tasked with providing quality education to all children. Classroom populations include students who struggle with sitting still. Each year there are a number of students whom teachers identify with terms such as *wiggly, busy, or fidgety*. Some of these students are diagnosed with Attention Deficit-Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), or Sensory Processing Disorder (SPD) (SPD), while others are just considered busy or inattentive. Some students simply require more movement. The goal in classrooms was to find ways to keep students focused, and these goals include ideas related to movement, fidgeting, and seating. Especially for the wiggly or fidgety students (Gregory, 2014; Hanscom, 2017). An accommodation that is aimed at supporting the need for more options in the classroom for all students is flexible seating (Merrill, 2017). The term flexible seating can refer to a number of different ideas, but is typically reserved for using anything safe outside of a standard chair. Flexible seating is one new trend in education that seems to be focused on the comfort and the needs of the learner that can be accomplished by

adapting and changing small features in the environment. It can include not sitting at all, or it can include using standing desks, cushions on top of crates, wobble stools, or comfortable chairs.

**Statement of the Research Problem**

The idea of flexible seating is not just popular; the real-world options for flexible seating have been increasing in availability and use among educators (Carter, 2017; Gal, Schreur, & Engel-Yeger, 2010; Kennedy 2016; Kennedy, 2017; Mayo Alumni, 2006). Determining if flexible seating is appropriate and worth the investment in time and money requires a careful review of the literature on the impact of environmental factors related to seating on student academic success. When reviewing the literature, it is relatively easy to find articles on flexible seating, but many popular blogs and magazines have not taken a deeper look into why flexible seating might be beneficial, nor have they considered what types of flexible seating might be most appropriate. With all the flexible seating options available to the lay person, it is difficult to know which choices might result in the best fit and provide the greatest positive impact on those using the seating options. Maximizing the opportunity for positive student outcomes is an important area of focus for school leaders, and the role of the classroom environment is one piece of that puzzle (Merritt, 2017). Almost any aspect of the learning environment can impact the performance of students (Kennedy, 2017; Merrill, 2017; Mayo Alumni, 2016). Classroom adapted furniture is an area that received quite a bit of attention. How seating impacts student performance directly addresses the trend of flexible seating.

Within the literature on alternative seating and its impact on student behaviors, active seating has been the focus of a significant amount of research. More specifically, a growing body of literature has investigations on the impact of the therapy ball. Active seating, or dynamic seating, as it is sometimes called, is defined as a seating apparatus that provides the opportunity

for the user to engage in movement while seated (Pfieffer et al., 2008). Movements could include wiggling, wobbling, bouncing, or pedaling to name a few. The majority of the research on active seating has been completed on the therapy ball (Erwin et al., 2016; Fedewa et al, 2015). The limited scope in the emerging body of research on active seating opened the door for additional research on other active seating options like the wobble stool. The wobble stool is a relatively new active seating apparatus that allows seated student movement at the desk.

**Purpose of the Study**

This paper reviewed the literature on movement and how it affected attention and concentration, which is the foundation of the idea behind flexible, or active, seating. A review of the literature on several seating options followed. Finally, there was a more in-depth investigation of the effects of the therapy ball on attention and work completion included. A review of the literature regarding the benefit of exercise on cognitive functioning and performance led to a review of the literature on the benefits of movement during instruction and task completion. This study addressed the issue of effectiveness of flexible seating in the classroom as it relates to student work completion and student work accuracy while using the wobble stool, a stool with a convex bottom that allows for movement in multiple directions while seated (Worthington, 2017). The goal is to determine if there is evidence of the wobble stool being an effective alternative to the standard classroom chair, similar to the studies that focused on the effects of the therapy ball (Al-Eisa et al., 2013; Bagatell et al., 2010; Burogyne & Ketchum, 2015; Erwin et al., 2016; Fedewa, 2015; Fedewa & Erwin, 2011; Goodmon et al., 2014; Kilbourne, 2009; Massey et al., 2016; Matin et al., 2017; Mead et al., 2016; Schilling et al., 2003; Wu et al., 2012) as they relate to attention, concentration, academics, and behavior. Given the previous research results and theoretical findings of the benefit of movement for

cognitive functioning, the paucity of the wobble stool research invited the examination of additional flexible seating options.

**Rational for the Study**

Much of the research published focused on attention and students with disorders of executive functioning, such as Attention Deficit/Hyperactivity Disorder, Sensory Processing Disorder (SPD), or Autism. This study examined the relationship of sitting on the wobble stool on work completion and work accuracy, quantitative educational variables, rather than looking at qualitative variables like behavioral observations, or by rating movements by using a movement tracking device. This study also took into account the effect on a student group by examining work samples completed with intermittent use of the flexible seating over the course of a brief time sample. This design was different from other studies that compared groups to one another. While being innovative, this study also could include possible confounding factors such as different teachers, teaching methods, expectations, race, class, socioeconomic status, gender, or other biases. as supported through the research. There has been limited evidence of published research about the effects of intermittent use of the wobble stool on work completion or work accuracy. With the popularity of flexible seating as a means to improve the learning environment and student outcomes, it seems important to identify which flexible seating options result in maximum student improvement. When considering the time and the money invested in the classroom and the importance of improved student outcomes in all populations of students, the timeliness of this study is relevant to the increasing demand for change in classroom environment.

## Theoretical Foundations

A review of the literature on movement reveals a large body of literature linking movement and cognition (Jensen, 2005). Jensen noted that the majority of neuroscientists support the idea that movement and cognition are powerfully linked. In his text, Jensen discusses a history of the discovery of the relationship between cognition and movement over the last 100 years. The cerebellum is the area of the brain most associated with motor control. The cerebellum is housed in the back of the brain, and contains nearly half of the brain's total neurons. This dense area of the brain provides the neurons for much of the outgoing messages to the rest of the body. Additional research by Strick as reviewed by Jensen traced a link in the brain from the cerebellum to the areas for memory and learning, revealing the same area of the brain processes both movement and learning (Jensen, 2005). This relation has significant implication for facilitating learning.

Similarly to how exercise strengthens other parts of the body like the heart, lungs, muscles, and bones, exercise also has a strengthening effect on three important parts of the brain including the basal ganglia, the corpus collosum, and the cerebellum. Exercise provides the brain with needed oxygen and also with nutrient-rich neurotropins, a chemical cocktail that helps elevate the amount of neuronal connections. In other words, exercise increases neuron growth (Jensen, 2005; Vivar, Peterson, & van Praag, 2016). Research revealed that brain cell growth was increased in rats who exercised versus ones who did not (van Praag, Christie, Sejnowski, & Gage, 1999; Vivar, Peterson, & van Praag, 2016). Additionally, the neurological benefits of exercise are linked to increases in cognitive processing, memory, and attention (Reichenbach, Halperin, Sharma, & Newcorn, 1992). The significant academic impact of exercise on school age children was noted as well (Donnelly et al., 2013; Erwin et al., 2016). Ample research

supports the positive impact of physical exercise on student academic outcomes (Dwyer, Sallis, Blizzard, Lazarrus, & Dean, 2001; Jensen, 2008; & Mahar, 2006).

Not only is exercise known to improve learning, seemingly other irrelevant movement like fidgeting may also improve learning. There is a growing body of research supporting the theory that there is both purpose and benefit behind fidgeting or moving (Gregory, 2017; Hanscom, 2014; Hartanto, Krafft, Iosif, & Schweitzer, 2015; Sarver, Rapport, Kofler, Ralker, & Friedman, 2015; Snyder, 2017; Wittberg, Cottrell., Davis, & Northrup, 2010). The research supported the benefit of movement or fidgeting during tasks requiring attention. Within this body of research, a portion of it was devoted to movement and its link to academic success for students with ADHD (Hanscom, 2014; Hartanto, et al., 2015; Fedewa, Davis, & Ahn, 2014; Goodmon et al., 2014; Mead, Scibora, Gardner, & Dunn, 2016; Sarver et al., 2015; Wittberg, et al., 2010). Hanscom (2014), an Occupational Therapist, noted that in order to make any real impact to improve attention and concentration students need to experience rapid vestibular input on a daily basis. This rapid vestibular input is similar to what children experience through authentic play like rolling, flipping, running, spinning, and being upside down which stimulate the vestibular system. Children need authentic play in which they experience a wide variety of physical activities that stimulate the vestibular system which is the complex system of balance for the body. Hanscom also references well-known experts like Rappart and Swietzer, whose respective research focuses on individuals with ADHD or other disorders affecting executive functioning (2014). One suggestion from her work is support for the ideas of the flipped classroom, and its potential impact of not just authentic play, but active seating on classroom attention and concentration.

The classroom environment typically includes the overall climate of the classroom as well as the physical components which include the structure and architecture, the design and layout, and the furnishings including desks, chairs, and access to learning implements (Merritt, 2017). The physical environment of the classroom houses a variety of components that could have an impact on the learning culture. These components could include how the classroom is arranged, the shape or size of the classroom, how students are grouped within the space, as well as actual materials that are used in the teaching and learning process. The classroom elements that teachers can employ daily to help achieve desired learning outcomes include time, space, resources, student groupings, instructional or learning strategies, partnerships, and presentation or teaching strategies.

**Research Questions and Null Hypothesis**

This study was guided by research questions in the area of flexible seating alternatives for students in the classroom as a way to potentially impact student performance. Since the wobble stool is classified as dynamic seating similar to the therapy ball, does the intermittent use of the wobble stool during independent seat work result in an increase in the amount of work completed or the accuracy of the work completed during the teacher assigned timeframe?

**Hypothesis 1.** Intermittent use of the wobble stool during independent seat work results in an increase in the accuracy of student work completed.

**Hypothesis 2.** Intermittent use of the wobble stool during independent seat work results in an increase in the amount of student work completed.

**Null hypothesis**. No cumulative change will occur in either accuracy or quantity of student independent work as a result of using the wobble stool as a seating alternative during independent work.

## Limitations and Delimitations

Limitations of this study were relative to the sample of students used, and the work samples that were collected. Each participant completed independent work on and off the wobble stool during the same school day. Subjects were not be differentiated, so it was possible that there were effects for different types of independent work that would not be reflected in this study, including student learning strengths and challenges with particular subject matter. Also, students were not divided by grade, race, gender, socio-economic status, or geographical location. The sample of students was dependent on the number of teacher volunteers who used the wobble stool in their classroom. Teacher volunteers were collected via social media blast and word of mouth with the area of focus identified as schools in Tennessee. Another concern was the number of students in the sample. The smaller the sample size the greater the possibility that the study did not offer data that is reliable; however, regardless of sample size, multiple work samples were be collected per student over a four week period, with half completed on the wobble stool and the other half completed while using regular classroom seating. Multiple work samples over time provided substantial student data. One last concern about the limitation of the study centers around the population of children studied. Studies with limited results included both students with disabilities and students without disabilities. Given that this study did not differentiate between students with or students without learning differences, it could be a factor that impacts the data.

## Definition of Terms

For clarification of terms, the researcher chose to define the following terms. Additional terms were defined in the literature, and in those instances, sources were cited.

**Active (dynamic) seating.** Also known as dynamic seating, active seating was defined as movement while seated (Pfeiffer et al., 2008). Any dynamic or active seating option is designed to allow for movement during seating and could include options like the therapy ball and the wobble stool.

**Wobble stool.** The wobble stool, or the active learning chair, as it is sometimes called, is defied by Worthington (2017) as an ergonomic seating option designed to change stationary sitting into an activity. This wobble stool was intended to be used at temporary sitting intervals. It has a convex base that provides for movement in all directions. The wobble stool is stable, light-weight, and made from a durable material. It has a lightly padded to prevent slipping off the stool, as to increase comfort.

**Executive functioning.** The term executive functioning is used to describe a set of mental processes that aids in the connection between present action and previous experiences (National Center for Learning Disabilities, 2003). Executive function is used when a person performs such activities as planning, organizing, strategizing and paying attention to and remembering details. People with executive function problems have difficulty with planning, organizing, and managing time and space. They also show weakness with working memory or *seeing in your mind's eye*, which is an important brain process to guide planning. Not only are students with executive functioning disorders considered throughout the research, but another group termed as having Sensory Processing Disorder (SPD) are also referenced.

**Sensory Processing Disorder (SPD).** Miller (2012) defines Sensory Processing Disorder (SPD) (SPD) as referring to how the nervous system receives information through various modes of input, then interprets the information and influences output and action. With Sensory Processing Disorder (SPD) (SPD), the sensory information received by the brain lacks

organization that results in responses that are appropriate to the input. Persons with SPD may have difficulties with the reception of the input and/or the response to the input. They can detect sensory input similarly to those without SPD. Once the brain receives the information it becomes jumbled and disorganized which results in responses that often are considered inappropriate in relation to the circumstances.

**Organization of the Document**

This research paper was divided into five distinct sections. Each section addressed a specific aspect of the research study. The first chapter examined the background of the study, identification of the research problem, purpose and rationale of the study, and the theoretical foundation behind flexible seating, including research surrounding the benefits of exercise on cognitive processes. In addition to a statement of the research question, the limitations and delimitation were discussed, and important terminology was defined. The second chapter comprised a comprehensive literature review on the topic. Literature topics reviewed included the classroom environment, history of classroom design, and research on the impact of seating. Flexible seating options were reviewed with a special focus on the therapy ball. Within the area of flexible seating, the literature review included undifferentiated student populations compared to research on students who have identified medical or mental health diagnoses of executive functioning disorders or Sensory Processing Disorders (SPD). Much of the therapy ball literature predominantly addressed students with executive functioning and/or Sensory Processing Disorders (SPD). Literature reviewed linked connections to the similarity of the therapy ball and wobble stool as both fit into the category of active seating. The relevance of this study was discussed. In chapter 3 the methodology was explained and included relevance to the research question and the null hypothesis. Statistical methods were reviewed. Chapter 4

focused on the results of the study, with implications for further research, and limitations of the study were discussed through chapter 5.

## Chapter 2: Review of Literature

Use of the therapy ball has been shown over and over to have a positive relationship to student attention, concentration, (Al – Eisa, Buragadda, & Melam, 2013; Fedewa, Davis, & Ahn, 2015; Fedewa, & Erwin, 2011; Matin, et al., 2017; Schlling & Schwartz, 2004; Schilling, et al., 2003; Wu, Wang, Chen, Lai, Yang, & Guo, 2012), and in-seat and classroom behavior (Bagatell, Mirigliani, Patterson, Reyes, & Test; 2010; Burgoyne & Ketcham, 2015; Fedewa, Davis, & Ahn, 2015; Matin, et al., 2017; Schilling & Schwartz, 2004; ). Studies have supported the relationship of use of the therapy ball to improvements in achievement (Fedewa, Davis, & Ahn, 2015; Mead, Scibora, Gardner, & Dunn, 2016; Wu et al., 2012), and even overall comfort (Al-Eisa et al., 2013; Wingrat, & Exner, 2005). Movement during instruction increases attention and work production. The opportunity to wiggle or fidget during instruction or task completion has been shown to have a positive effect on tasks requiring concentration and attention. This is especially true for use of the therapy ball.

The wobble stool functions in a similar way to the therapy ball in that it allows the user to move in multiple directions, and requires engagement of the core muscles to maintain balance. Movement in all directions is integral to student development because physical movement results in an improvement in overall well-being, as well as supports both physical and intellectual maturational processes (Worthington, 2017). The study on the impact of the wobble stool on task completion and task accuracy would provide important information about the benefits of the wobble stool for use in the classroom setting as a viable and research based alternative to traditional seating. As the trend in flexible seating gains momentum, information that directly speaks to its impact on positive student outcomes would be invaluable as educators seek to identify additional ways to support students. Given that flexible seating could mean any non-

traditional seating mechanism, research on the exercise or therapy ball, also known as active seating, has shown promise of real impact, especially for students who may have executive functioning or sensory needs. In an effort to address the effectiveness of flexible or alternative classroom seating, research on dynamic or static seating options could provide extensive support and insight to teachers and students. In addition to wanting ideas and strategies that work, teachers are more inclined to try things that are proven, as well as simple. Barriers to inclusion for all students in the learning environment is an historic challenge, especially when classroom teachers feel underprepared to meet the needs of the child (Gal, Schrear, & Engel-Yeger, 2010). Teachers with simple, direct, research-based options would be better equipped to meet the needs of all students, including those identified as having learning differences, including sensory and executive functioning challenges.

The wobble stool, like the therapy ball, falls into the category of seating options referred to as active or dynamic seating. It stands to reason that if one dynamic seating option has shown impact on student outcomes, that other dynamic seating options might also show impact on student outcomes. The inquiry into effective seating revealed evidence to benefits of active seating, especially when addressing the needs of students with disabilities. Seating changes as part of the environment of the classroom were investigated.

## Classroom Environment Impact

**Classroom environment.** The physical classroom can be used as a tool to impact student growth and to transform students into active learners (Faulk & Evanshen, 2013). Made up of a variety of components, the classroom environment is a combination of the physical components and the interactions and activities that take place as part of the teaching and learning process (Merritt, 2017). Some of these components include the physical structure of the

classroom, the furnishings and layout, the materials, the grouping of the students, and the personalities and interactions that take place to create the learning milieu. When a teacher utilizes these components, and recognizes the power in changing a component to impact student outcomes, that teacher then unlocks the potential to create a learning environment that can change and adapt based on the learning needs of the students. Teachers can use these components to facilitate energy and enthusiasm in the learning process (Faulk & Evanshen, 2013).

An active learning environment provides space and opportunity for collaboration (Carter, 2017), with the idea that movement throughout the room is essential to active learning. As defined in the literature, active learning can include a number of different strategies that fall outside of the traditional lecture model (Edinger & Lee, 2017). Active learning implies a change in expectation of both the instructor and the student. When polled, teachers and students reported more interest in learning environments that were active rather than static. Classroom from the 19th and 20th centuries were relatively static (Merritt, 2017). In the 21st Century active learning environments are the new typical classroom. Not only are the methods of instruction and the design of the learning environment substantially different from those past eras, the structure of the classroom from past eras also does not fit with the requirements of the updated educational standards and vision of modern education. Kinesthetic learning models encourage educators to *ditch the desk* and instead opt for more movement throughout the learning experience to move the learning to a deeper level (Mobley & Fisher, 2013). In order to take advantage of purposeful partnering, gallery walks, and human demonstrations (like that of students pretending to be the planets of the solar system who rotate on axis and orbits around the sun), classroom environments must be structured to support a variety of learning experiences.

The environment of a classroom can have influence over student mastery of concepts (Roskos & Neuman, 2011; Merritt, 2017). Students need equal opportunities for access to positive environments to promote active learning. The arrangement of the classroom should allow for purposeful student activity (Faulk & Evanshen, 2013; Kennedy, 2017). For the most positive outcomes and to engage the student in active learning, the learning environment and the arrangement of the classroom have to provide an appropriate arrangement for both range and depth of the teaching and learning process. Teachers are tasked with finding balance between the needs of individual students with the those of the entire group. Consideration of which factors can change within the classroom environment, and an understanding of these changes that can meet the needs of a variety of students (Carter, 2017; Gal et al., 2010; Guardino & Fullerton, 2010; Kennedy, 2016; Kennedy, 2017).

**Classroom arrangement.** The design and layout of a classroom, or the physical design, provide clues as to the expectation of those who participate in the learning experience (Roskos & Neuman, 2011). Within the structure and arrangement there are small suggestions that are insightful for the onlooker about cultural norms, behavioral expectations, and academic expectations. The environment should match the expectation of how learning occurs, as well as the tasks that are going to be completed. In other words, learning expectations should be linked with purpose to the arrangement of the physical classroom environment. Cozy areas, comfortable seating, and seating groupings might suggest that social learning, partner learning, or group learning are valued by the instructor. A room with a variety of learning centers and open space might suggest the opportunity and the expectation that students would move throughout the day and transition from one place to the next for different types of learning

experiences. A room with desks lined up in rows facing the front of the room offers the idea that there is little expectation for movement and interaction. That *old-school* design might also offer the suggestion that social learning, small group, or partner learning is not within the expectation of that classroom. Students ascertain the purpose of the learning by the design of the learning space (Faulk & Evanshen, 2013; Oiver & Kostouros, 2017). Associations begin to develop that differentiate certain learning spaces for specific learning tasks. These purposeful groupings provide structure not just to the physical classroom, but to the way learning is experienced by the students. Purposeful arrangement of the space sets the stage for the culture and climate of learning.

In the 19th century, elementary classroom teachers in the United States have controlled most of the classroom setting (Merritt, 2017). Historically, classrooms were governed by strict rules and procedures where teachers maintained full control over student seating with no opportunity for student choice (Oliver & Kostouros, 2017). The arrangement of the classroom typically included an arrangement of desks in straight rows that matched a lecture-based model of instruction. This arrangement of desks in rows also met more practical needs for ease of custodial services. In historical times control and strict discipline were believed to be essential as the instructor at the front of the room commanded the attention of the student. The lecturer was assumed to be wise, and there was little to no reciprocity in the learning process between the instructor and the student. When desks are in rows, there is an assumption of expectation for student participation in the learning that goes as unspoken. These assumptions include the expectation of sitting while facing forward, the expectation that there will be no collaboration or social component, and the expectation that there will be no movement through the classroom. Current instructional practices have evolved from the lecture-based instructional model with its

limited effectiveness; however, the old classroom structure has been a characteristic of public education for more than 100 years in the United States.

**Seating.**, A study was published in 2005 by Wingrat & Exner specifically centered around the idea that environmental factors can influence student sitting and on-task behavior that examined the impact of school furniture. The research team sought to identify the relationship of size and fit of the furniture to any impact on sitting behavior or on-task behavior. The findings of the study indicated that both boys and girls showed improvement when seated in smaller furniture that fit their size rather than in larger furniture too big for their size. Another study by Knight and Noyes from 1999 noted an overall increase in both on-task and sitting behavior when children were seated in an ergonomically designed chair versus a standard classroom chair. Student choice in seating furniture was discussed as a possible motivating factor in improving overall outcomes (Kennedy, 2017; Knight & Noyes, 1999; Tucker, 2017).

The popularization of alternative learning environments, flipped classrooms, and student led learning have brought considerable attention to the design of the classroom (Mayo Alumni, 2006). New information is now shared via online blogs and webpages where teachers and administrators share anecdotes and strategies that shape the framework of idea exchange. For many professionals, online resources from professional blogs and magazines have taken the place of research based articles. Professionals in education now rely on sites like Edutopia for the latest information about strategies to shape student outcomes. Professionals rely on each other to share proven methods. It is difficult to not trust in something that comes from a popular website or blogger. Ideas about classroom design and flexible seating are plentiful through education magazines and online websites.

Within the popularity of having student-led learning is also the notion of student designed and defined work spaces, which includes seating (Kennedy, 2017; Tucker, 2017). Student choice was identified as an important and developmentally appropriate part of a child-centered classroom (Faulk & Evanshen, 2013). Choice of materials and choice of seating options are two ways that the teacher can support the individual needs and learning styles of the students within the learning environment without having to change the instruction or the requirements. By providing the options for alternatives within the structure of the classroom environment, the student has control over making small changes as needed to maximize positive outcomes. Some of the benefits of alternative learning environments, including alternative work stations and seating, include better defined learning spaces, clearer expectations for use of the area, reduced negative behaviors, and improved student engagement (Carter, 2017; Guardino & Fullerton, 2010; Tucker, 2017). Redesign of the classroom as an intervention for reducing problem behaviors and increasing student engagement for students has been proven effective for a classroom setting (Guadino & Fullerton; 2016). In addition, this type of classroom redesign has shown improvement in the same areas for students with learning differences (Faulk & Evanshen, 2013; Guardino & Fullerton, 2010; Tucker, 2017). Classroom engagement was cited in one study to increase from 3% to 45% with a few changes to the classroom environment. Seating options, and classroom design clearly have some impact on student performance. Given that students are in chairs for extended periods of their school day, seating flexibility as a way to combat challenges with engagement, fatigue, and behavior shows some promise. (Carter, 2017' Guardino & Fullerton, 2016; Matin, et al., 2016; Tucker, 2017). Adding to the support for this change in seating are the concepts of the impact of the classroom environment, including the

structure, design, arrangement, and materials (Faulk & Evanshen, 2013; Mayo Alumni, 2017; Roskos & Neuman, 2011).

Students who were uncomfortable in their seats had less chance of positive academic outcomes (Al-Eisa, Buragadda, & Melam 2013). Improvements were noted for students who used therapy balls in the areas of handwriting, clearer understanding of presented concepts, and organization. After beginning the therapy ball as a classroom seating option, students were more comfortable based on self-report. There were also notable increases in overall student performance. When on-task behavior improved, then student outcomes also improved. Better comfort has a link to performance outcomes for behavior and academics.

> Assumptions have been made based on a positive learning environment and the students' increased abilities to focus. With increased on-task behavior, the ability to focus on reading and writing for prolonged amounts of time, and an increased ability to complete reading, writing, and mathematical tasks, the use of therapy balls in the classroom has the potential to improve classroom performance and facilitate learning. (Massey et al., 2016, p. 56)

Additional research is needed to identify the full effects of active, or dynamic, seating on academic performance given the limits in the research. With the positive impact of movement on cognition, as well as the potential for feedback systems within the body to increase time and attention to important cognitive tasks with increases in movement during those tasks, the field of research on the impact of active seating is wide open for investigation.

**Standing desks.** Additional emerging, yet limited, research on standing desks and adjustable desks where the user is required to stand has been published over the last few years (Sudholz et al., 2016). Only one study has been published on height-adjustable desks that

revealed positive outcomes for academics and musculoskeletal impact. That study provided limited understanding of the impact on academic outcomes of adjustable desks, as their focus was more on the musculoskeletal benefits. The academic outcome measure used was overall student grades. The study published by Sudholz et al. (2016) was born of the ideas that came from the Koskelo study from 2007 published in *Ergonomics*. Sudholz et al. investigated the impact of replacing traditional classroom desks with height-adjustable desks for 43 adolescent students (2016). The students were rated for amount of time sitting when using the standard desk as compared to the amount of time spent sitting when using the adjustable model. Students also provided as self-report of interest in continued use of the adjustable desk. Seventy percent of the students reported wanting the opportunity to use the standing desk. Although no academic outcomes were measured in this study, both teacher and student self-reports were collected on ability to concentrate, quality of work, and overall comfort/perception of comfort. Over one-third of the students reported that they had difficulty concentrating and became distracted while standing during the lesson. Nearly 70% of the students reported that they worked well while using the standing desk. Teacher report suggested limited perception of negative impact on students' ability to work or concentrate at only 14% each. Of the 43 students who participated in using standing adjustable-height desks, half endorsed pain in their legs or back while standing. Although there was some evidence that overall sitting time is reduced by standing at a desk rather than sitting at a desk, this study provided limited support for the benefit of the standing desk in the classroom setting. Since student comfort was noted as important through other studies on classroom environment and student outcomes as well as studies on seating comfort and student outcomes, this revelation that students were uncomfortable with the standing desk is helpful in making choices for alternative seating.

Another study was completed in 2016 (Windell, Binden, Zhoa, & Jeffery) that examined the outcome on body mass index (BMI) when students used standing desks for two consecutive years rather than seated desks. The study was completed in Texas and included 380 students from 24 different classrooms in three different schools. Although no academic outcomes were measured or noted, significant reduction in BMI for students using the standing desks suggests potential positive outcomes of overall health benefits.

A study investigating the neurocognitive benefits of using the standing desk was published in 2015 (Mehta, Shortz, & Binden) which highlighted some of the possible outcomes for students in the classroom when using a standing desk rather than a traditional desk. While standing desks are known to combat sedentary behaviors in the school setting, and that there are numerous health benefits associated with less time sitting, the additional potential benefits in the academic setting have remained unclear. The impact of increased sedentary behaviors over time on children's cognitive functioning is unknown; conversely, the impact of decreased sedentary behavior is also an unknown. In the Mehta study, neurocognitive benefits in executive functioning and working memory were measured in a group of 34 high school freshman. The study incorporated testing of the subjects on two separate occasion in the study. One measure was taken in the fall, and then another was taken 27 weeks later in the spring. Measurements included a neurocognitive battery that was computer based and functional near infrared spectroscopy as a method of detecting brain activation patterns in the prefrontal cortex. Study results suggest that continued use of the standing desks was associated with positive changes in brain activation patterns and in executive functioning. These results suggest that there are additional cognitive benefits to the stand-biased desk in addition to the noted potential health

benefits. As a pilot study, the findings offer implications for further study into benefits of a variety of different seating options.

Generally speaking the research on alternative seating is limited and emerging. What research is available outside of the therapy ball seemed to have more focus on the health impacts for students, relation to the classroom environment, and to the comfort of the student than on academic outcomes. Academic outcomes could be by-products of student comfort or positive classroom environments. The research lacked information on the academic impact as well as the underlying reason for any potential impact.

## Movement and its Relationship to Student Outcomes

**Movement and sensory needs.** Movement during instruction is suspected to have an important role in the learning process (Jensen, 2005; Sarver et al., 2015). A small study of 29 boys with ADHD and 23 boys without ADHD suggests that children with ADHD need to squirm to learn. For example, many students with ADHD might get better marks if they could do classroom work, tests and homework while sitting on activity balls or exercise bikes (Rapport et al, 2009). The study suggested that students with ADHD did better the more they moved while students without ADHD did more poorly. Children with ADHD have to move to maintain alertness. This has implications for interventions with students both with and without ADHD for classroom accommodations and work space considerations. Their study examined the activity levels of children with and without ADHD for tasks of working memory (Rappaport et al., 2009). Movement was measured in seconds using monitors on the wrists and ankles. Results of the study suggested that all children increased their motor activity during these demands for working memory, but children with ADHD diagnoses experienced significantly higher increase in motor activity than the non-ADHD peers during the demand for working memory. A

limitation in this study was the number of participants with only twelve peers in the ADHD group, and eleven peers in the non-ADHD group. Even with a small sample size, there are implications that all students have a need for some form of movement during tasks that require working memory.

In order to gain a better appreciation for the differences that are noted with attention, on-task behavior, and sensory input, a review of some key features seems appropriate. Research suggests that Attention Deficit/Hyperactivity Disorder (ADHD) has little impact on motor coordination (Piek et al., 2003), but does impact working memory (Kasper, Alderson, & Hudec, 2012) and attention (Kofler, Rappaport, & Alderson, 2008). Although attention and working memory are well-known components of ADHD, how they impact the student in the classroom environment has not always been readily captured by rating scales or checklists that teachers complete. This is due in part to the poor way that these items are requested from teacher or parent memory, rather than a quantifiable method based on observation or data collection as it relates to behaviors requiring attention and concentration. The meta-analysis of 23 independent studies (Kofler et al., 2008), all using some method of direct observation, revealed that out of the entire population of students, those with ADHD were on-task about 75% of the time, whereas their non-diagnosed peers were on-task about 88% of the time. Implications from this analysis were that better data need to be gathered using observation, rather than recall methods of ranking student symptomatology. Further implication for this observational model is to discover the barriers in the classroom setting for children who may be off-task or inattentive so they can be addressed through appropriate interventions for the classroom.

A study of a class of 4$^{th}$ graders and a class of 2nd graders (Ma, Mare, & Gurd, 2014) demonstrated that movement breaks versus non-movement breaks of the same length have a

positive impact on off-task behavior for students. These authors reference the theory that short or acute intervals of physical activity improve overall cognitive functioning, improve concentration, and result in positive impacts on academic achievement. Effects of these brief bursts of physical activity were easy to implement in the classroom. Additionally, the reduction of off-task behavior as a result of the brief activity bursts were noted to be more significant in students who demonstrated higher levels of off-task behavior on non-activity days. Another way to interpret this information is that students who had greater levels of off-task behavior on days when there was limited opportunity for activity had the most improvement in the on-task behavior when activity breaks were incorporated. Students with learning differences for attention, concentration, and sustainability of mental energy were improved when activity bursts were intermingled throughout the day.

**Movement and cognitive tasks.** There are other methods that researchers have used to look at the benefit of movement and fidgeting, especially related to fads or anecdotal discoveries. One fad that was made popular for a while was that of chewing gum to increase attention and concentration (Onyper et al., 2011). The advantages of chewing gum were examined for cognitive tasks. The overarching assumption in the theory is that the arousal systems are engaged by the physical activity of chewing, with another theory cited by Onyper et al. (2011) that suggested improvements were based in the higher available levels of glucose in the brain due to the action of chewing. Initial studies on gum chewing from the early 2000s were reviewed by the authors. In addition, multiple subsequent studies reviewed by the authors were unable to provide evidence across tasks to demonstrate a positive relationship between gum chewing and cognitive performance. In this study by Onyper et al., chewing before the task was compared to chewing during the task, and then measured against not chewing gum at all. The

authors discovered that there was a positive effect for chewing gum five minutes prior to a task but not during the task, and that the time span for efficacy was about 15 to 20 minutes into the task. Effects, limited effects, and no effects were inconsistently demonstrated throughout the literature as cited in this research article. The proposed reason for the conflicting evidence is based on dual-process mechanism, or interference of one process due to the other process.

In the field of occupational therapy, the literature most relevant to this study on the wobble stool is related to the importance of movement as it effects balance in the vestibular system (Hanscom, 2017). A growing issue in occupational therapy is the relationship between movement and attention and concentration. Hanscom has published several articles related to the connections and benefits of movement and learning. She proposes that in order to create actual changes to the sensory system that result in more long-term improvements in attention, students require rapid vestibular input every day. The author noted that they types of movement children need to experience includes spinning, rolling, and going upside down. Her position was that children benefit from authentic play experiences allowing movement in all directions, which is necessary to stimulate cells found in the vestibular complex. The vestibular complex is also known as the little tiny hairs in the inner ear, and is the center for balance. Hanscom asserts that children need this all around movement regularly, and for a significant amount of time, for proper balance system development. The effectiveness of the balance system impacts attention and concentration.

In another study assessing the specific needs of children with ADHD, Haranto et al. (2015) also arrived at the conclusion that children with ADHD need the opportunity for purposeful movement during cognitive tasks. Their driving idea is that the activity itself is what helps the student to focus. These authors added that they believe that limiting activity is

detrimental to children with ADHD. The study was conducted in a clinic setting, and leaves open the implications for future research to study the idea in a more natural educational setting. This big idea that not having the ability to move is a detriment to students with ADHD could also have implication related to other fidgeting or movement interventions, especially in conjunction with the popularization of fidget devices, like the fidget spinner.

In their study of students with and without ADHD, Hartanto et al. (2015) used psychometric assessments, and rating scales to identify students with ADHD. They excluded from the study students with full-scale IQ scores under a standard score of 80, and they included children with one Conners rating t-score of 65 or greater. Parent interviews were also used. Students with other comorbid Axis I diagnoses were also excluded. This study expanded on previous studies where the frequency and duration of movement was measured in children with ADHD while performing a cognitive task requiring focus and attention. The study was conducted in a lab setting with the students free from distraction and off any prescribed psychotropic medications.

Hartanto and colleagues noted that parents and teachers shouldn't try to keep kids with ADHD still. They should allow the students the opportunity to move while they are doing their work or other challenging cognitive tasks. The authors postulate that the hyperactivity in ADHD is actually beneficial at times. They also postulate that the movement the student is engaging in might increase their arousal level, which leads to better attention. In this study students, between the ages of 10 and 17 years old were identified to participate in a study completed by the MIND Institute of California. Twenty-six of the children were identified to have the diagnosis of ADHD, and 18 children were typically developing, and had no diagnosis.

Movements of the student participants were measured by a device attached to their ankles. The device measure activity level during a time when the student participant completed a *flanker test.* The flanker test required the participant to utilize cognitive energy to direct attention to the task as well as to inhibit devoting attention to a distraction stimulus. The student participant was required to focus on the middle arrow in a series of arrows, with specific attention to the direction the middle arrow is pointing all the while ignoring the other arrows in the series that were flanking the middle arrow. Sometimes the flanker arrows pointed the same direction as the middle arrow, and other times all the arrows pointed in the opposite direction. Errors are more likely in the stimulus where the flanking arrows point in the opposite direction. Interestingly, there was a significant increase in the accuracy of student participants diagnosed with ADHD if they were moving. Correct answers were more likely to occur with an increase in motion as measured by the ankle monitor. Movement in children with ADHD improved cognitive task outcomes significantly over the same task when sitting still.

## Dynamic Seating

**Stability ball and sensory issues.** Another concept central to the research has more focus on the effects of flexible seating with the therapy ball as it impacts student potential in students who may have executive functioning disorders such as ADHD, Sensory Processing Disorder (SPDs, or other neurological differences like ASD as compared to those students without a diagnosis. Sensory integration is an important part of the learning process (Burgoyne, & Ketcham, 2015). The brain is tasked with filtering sensory input that is constantly incoming to determine what needs to be attended to for each situation. As situations change, so does the need for the brain to process the different signals and messages. The brain is in a constant state of determining what is important and what is not for any situation, while simultaneously planning

and executing responses to the important stimuli. This process happens fairly rapidly for healthy individuals. For those individuals who have sensory processing challenges, this process is more difficult, and difficulties are noted in executive functions like planning and shifting as the demands of the environment change.

There appear to be three main systems for sensory processing that related to daily functioning (Burgoyne & Ketcham, 2015). They include visual input, proprioceptive input, and vestibular input. Together proprioceptive and vestibular input provide information about the body in space as it relates to movement, including force, and head position in space that deals with both posture and balance. These systems also work in concert to produce body responses that are precise and coordinated based on the specific demands from the environment and circumstances. Sensory processing is developmental in its nature rather than an all-or-nothing skill. It develops over the life-span. Just as there are typical rates and routes of progression for many other developmental skills, the same is true for sensory integration. Challenges and developmental lags can be part of the developmental process. Also, children develop different sensory integration skills at different times; therefore, these differences in sensory integration skill have the potential to impact students at all levels of education. Students within the same classroom may be at varying levels of sensory integration development.

Stability ball use in the classroom has been studied through numerous researchers, with some implication that the ball is most effective for children who have sensory issues like those related to ADHD or ASD (Bagatell et al., 2010; Schilling & Schwartz, 2014)). Over or under-stimulation from the student environment may be better mediated with a strategy or intervention designed assist the brain in processing sensory information. This could keep distracting stimuli from averting the student's focus. Some individuals can endure stimulation of more than one

sense at a time and still respond appropriately to the specific situation (Erwin et al., 2016), whereas other individuals require additional practice for the brain to process the multiple pieces of incoming information, and respond in a manner fitting to the given situation. Although many people can process multiple sensory inputs with relative little difficulty, others with SPD find it more difficult. This filtering and appropriate response to multiple sensory stimuli is a result of the work of the vestibular and proprioceptive systems (Case-Smith & O'Brien, 2014). The use of the stability ball allows greater opportunity for sensory input by engaging the vestibular and proprioceptive systems as compared with standard desk chairs. This increased opportunity for input was partially due to the opportunity the ball provides the student to be active all the while maintaining an optimum level of arousal (Schilling & Schwartz, 2004). It stands to reason then that the stability ball might serve more than the singular function of a behavioral intervention tool. Students who are either over- or under-stimulated benefit from assistance or intervention that assists the brain in filtering out potential distractions.

When investigating the impact of seating on pre-school children with ASD, Schilling & Schwartz (2014) were expanding previous research by Schilling et al. (2003) with the goal of answering three research questions for students with ASD. The questions included the effect of the therapy ball as a chair on in-seat behavior, the effect on engagement, and what were the perceptions of the teachers about using the ball as a chair in the preschool classroom setting. Four preschool children with ASD participated in a single subject withdrawal design. Data collected reflected time sample observations focused on in-seat behavior and engagement similar to that measured in older students with ASD in 2017 (Matin et al.). The preschool study added one variable for one of the four children to evaluate frequency of oppositional behavior. All four participants showed significant improvement for in-seat behavior while using the therapy ball,

similar to the results in Matin's study (2017). In addition, the students and teachers endorsed a preference for using the therapy balls when offered a choice between standard seating and using the therapy ball (Schilling & Schwartz, 2004). Many additional positive behaviors were reported anecdotally from adults working with the preschool students, including completing assignments, higher levels of responsivity, increased independence and tolerance for transitional time between activities (i.e.; remaining seated while waiting for another activity to begin), and increase in engagement. Autism Spectrum Disorder (ASD) is complex, and encompasses a variety of challenges that are different among individuals with ASD. It would be difficult to generalize the finding of such a small study to the entire population of students with ASD, but according to the authors, this lays a foundation for positive opportunities in intervention for students on the spectrum.

One observational study completed investigated the impact of the therapy ball on outcomes in the classroom over the course of three separate 1-hour-long observations (Burgoyne & Ketcham, 2015). The students in this study were not divided into students with and without sensory processing or executive functioning differences. All students were included in the study group. The results of the study addressed five categories relating to proprioception and the vestibular system, including seated behavior with and without therapy balls, behavior on the therapy balls, *other* behavior with the therapy balls, and position on the therapy balls. What the researchers found was that 47% of the behaviors observed while students used a standard chair fell into the stationary classification. While students were seated on therapy balls, observational data showed that 34% of the behavior was stationary. In addition, the observational data collected revealed that while students were seated in the standard classroom chairs they were engaged in on-task behavior 50% of the time, whereas when they were seated on the therapy ball

that on-task engagement was rated at 85 percent. Another interesting finding from this study was the number of different seating positions students used while seated on the ball (e.g.; W-sit, kneeling, or leaning). Based on the model of input and processing, the ball allowed for students to gain increased proprioceptive input through seating position, as well as vestibular input through movements such as bouncing or rocking. The two systems together help the body arrive at both coordinated movement as well as balance. How this relates to functional school tasks remains a question for further study.

In addition to the stability ball there has been some research on another active seating option, the Disc-'O'-Sit cushion (Pfeiffer, Henry, Miller, & Witherell, 2008; Matin, 2017). Dynamic seating implies movement while being seated. Decreased stimulation is believed to be a side effect of remaining in one position over a period of time. As a dynamic seating option, the Disc-'O'-Sit cushion is a round, inflatable disk that sits in the seat of a standard chair. Fullness with air can be adjusted. In particular to the study of the impact of the Disc-O-Sit cushion, there were 63 second grade students divided by random assignment between the control group of 31 students and the treatment group of 32 students. The purpose of the study was to identify any significant changes in the perceived behaviors of students who were identified as having greater attention difficulties as rated on the pre- and post-test using the *Behavior Rating Inventory of Executive Functioning (BRIEF).*

Students in the treatment group sat on the cushions for 2 hours per day for a two-week period while the control group remained in their chair for the same period of time. At the end of the two-week treatment protocol, students were rated by their teacher for the post-test. The results of the ratings suggested that students using the cushion were significantly improved over the students who did not. Improvements were noted for the entire population from using the

cushion, and the authors suggested that students with executive functioning challenges would benefit from using the cushion in the school setting.

**Stability ball and academic outcomes.** The research on academic outcomes when using the therapy ball in the classroom is limited and inconclusive. (Burgoyne & Ketchum, 2015; Fedewa et al., 2015; Massey, Horberg, Lynch, and Wiele, 2016). The earliest study to quantify systematically the effect of the stability ball on student output was one published in 2003 (Schilling et al.). It focused specifically on students with ADHD and their level of out of seat behavior. Over a 12-week treatment period using the stability ball, it was noted in all 3 participants, that their legible word productivity significantly increased since implementation of the stability ball. Although legible word productivity is only one small area of potential academic outcome, it nonetheless gives rise to the idea that improved on-task and in-seat behavior does reach into student productivity. Due to the number of participants it is difficult to know if these types of results would be probable on a larger scale.

Due to improved attention and in-seat behaviors while using the therapy ball, children with ADHD have also experienced improved academic outcomes (Fedewa & Erwin, 2011; Wu et al., 2012). The ball allows for the student to move in response to potentially changing sensory needs throughout the learning and work production processes (Schilling et al, 2003). Sensory needs can change with different demands from things in the environment, including people, and tasks (Burgoyne & Ketcham, 2015; Fedewa & Erwin, 2011; Schilling et al., 2003, Wu et al., 2012). A study that surveyed teacher beliefs about student academic success while using the therapy ball (Massey et al., 2016), resulted in overall positive indicators of effectiveness; however, this was based only on teacher report, and not on any collected data, observations, time samples, or grades, or other quantifiable markers of improvement. on reading outcomes for

students who were using the therapy ball, as well as suggestions for integrating the ball into the classroom.

The 2015 study by Burgoyne and Ketcham took observational data on 19 students over an hour period on three different sessions. Two session observations were of students engaged in classroom activities while on the therapy ball, and one observation was of the students while seated in standard chairs. Observations of the students' behaviors were completed by the researchers while students were seated on each seating option. The students were observed for being on or off task, interactions with others, level of effort, participation level in activities of the classroom, and seated behaviors such as bouncing, rocking, or sitting still. Although no academic data were taken, the researchers were able to provide evidence for increased attentiveness and on-task behavior while using the therapy ball.

The impact of the therapy ball and other types of exercise on standardized math scores was evaluated over the course of a one-year time span (Mead, Scibora, Gardner, & Dunn, 2016). The subject pool was three sixth grade math classes who utilized the exact same curriculum for math. Each of the three math classes was taught by a different teacher; however each of the three math classes had the same teacher throughout the entire year. The measures used were the Measures of Academic Progress (MAP) and the Minnesota Comprehensive Assessment (MCA) tests, both standardized assessments of mathematics. Each class utilized a different treatment protocol: one class did no physical exercise during instruction, one did two 5-minute breaks for physical activity during math, and the remaining class used therapy balls during math instruction each day. This study is one of the only published study that investigated the impact of the stability ball on academic achievement. The results were computed using a one-way ANOVA to flesh out any differences among the three classes on the pretests, which revealed no significant

differences on either test between the classes. A similar method was completed on the difference scores from pre- and post-test for the classes to identify any differences. First the MAP scores were compared. Scores were noted as significantly higher for class that used stability balls over the class that did no exercise, but was not significantly different than the class that engaged in exercise breaks. There were no differences found between genders. Next, the MCA test was compared among groups based on the difference scores. Results indicated a significantly higher score for the class that used stability balls over the class that had an activity break, but not over the class that had no activity. Although there were limitations to the generalizability of the data, there is some evidence that the therapy ball does have a positive and significant impact on math achievement.

**Stability ball and behavior.** Erwin et al. (2016) posed the idea that the type of physical activity engaged in by a student on a stability ball might be qualitatively different from the type of activity done while running, playing a physical game, or other moderate or vigorous gross moto behavior. They investigated the level of physical output of students while on the stability ball and while seated in traditional classroom chairs by using am accelerometer to calculate student output. The level of activity for students was measured for both the ball and the standard chair, and behavioral observations were added for 8 out of the 12 study participants to identify any differences in on-task behavior. In another study, the outcome for use of stability balls was the finding that they do not detract from the learning environment (Erwin, Fedewa, Ahn, & Thornton, 2016). In other words, they are not distracting for students. This is an important study because it shows no negative impact to using alternative seating. The authors help dispel the notion that flexible seating using the therapy ball is in any way detrimental.

As reported by Fedewa & Erwin in their 2011 study, Schilling and colleagues (2003) were the only team to systematically evaluate the effect of the stability ball as it relates to students with ADHD and its impact on their behavior. Schilling et al. (2003) utilized quantitative data rather than qualitative data alone in their investigation into the impact of the stability ball on their study subjects. The Schilling study (2003) focused on 3 fourth-grade students with ADHD diagnoses. These students began use of the stability ball, and data were collected for out of seat behavior over a 12-week treatment period. The results indicated a significant improvement for each of the children over the course of the intervention for in-seat behavior. Limitations of the study were noted to be small sample size, students in only one class, and limitations of only measuring in-seat behavior as opposed to on or off task behavior. Fedewa and Erwin (2011) used the Schilling et al. (2003) study as a springboard for addressing the above limitations with two goals. The first goal was to determine if using the stability balls resulted in an increase in the how often on-task and in-seat behavior were observed, specifically targeting students with elevated teacher concerns in the areas of attention and concentration. The second goal of the research team was to determine perceptions of the students and the teachers of using the stability balls in place of standard chairs. Results of the Fedewa and Erwin (2011) study revealed an increase for in-seat and on-task behavior for both student groups, those with ADHD and those students in the classroom without that diagnosis. The sample size was 76 students, 5 of whom had ADHD formal diagnosis, and 3 who were considered to have the diagnosis although it had not been verified. At the end of the treatment, it was noted that all 76 students improved on the level of hyperactivity by using the stability balls. The most significant result of the study was with the 8 students who were classified at the 92$^{nd}$ percentile or above on difficulties with attention and hyperactivity. The improvement in both attention and

hyperactivity was noted as “dramatic” by the authors (2011, p. 397). Both in-seat and on-task behaviors showed improvement when using the stability ball. Teacher perception of the effectiveness of the stability ball was high at the end of the treatment, although teachers also reported they were skeptical of the usefulness of the ball before and during the first few weeks of the study.

Another study was completed in 2012 by Wu et al. that investigated the impact of the stability ball on “attentional ability” (p. 1177). The authors point out that children with ADHD can have challenges with sensory modulation that adds to difficulty with attention. They suggest that for students with ADHD, sensory modulation deficits make the students…

> ...unable to pay attention to a lesson in a noisy classroom, or participate comfortably in family activities. Sensory integration techniques (SST) appeal to the three basic sensory systems: the proprioceptive system that regulates the awareness of the body in space, the vestibular system that controls sensations of gravity and movement, and the tactile system that controls the sense of touch. (2012, p. 1177)

One suggestion is that children who are overexcited could calm down while using the ball.

Wu and colleagues referred to the widely accepted P3000 brain wave as a way to measure reaction time on an auditory task for children who were diagnosed with ADHD as compared to otherwise healthy children who did not have the diagnosis of ADHD (2012). The student groups were measured for this activity while using the therapy ball and while seated on a traditional class chair. The study included 15 peers in each group matched for age, weight, and height who attended the same school. A 48-inch therapy ball was inflated to the proper size in order that each participant was adequately supported with both feet on the floor, and both hips

and knees at a 90-degree angle when seated. Each ball was secured by placing it in a looped pipe enclosure, keeping the ball from rolling, yet allowing sway to be contained to under one centimeter in any direction. The student subjects were taught the target and the non-target tones, and instructed on how to use the reaction button to signal. Electrodes were applied to three points on the forehead of each subject and connected to an EEG machine. All reactions and stimulus were measured through a computer system. Students were tested while sitting on the ball and while seated in a standard wooden chair. Students were given a 30-minute time frame on the ball and the chair to acclimate prior to the testing each time. Over the course of each of three sessions per seating condition, the student would hear 120 non-target and 30 target tones in a time frame of approximately 5 minutes. Results included that students without ADHD had faster reaction times while seated on the wooden chair. Students with ADHD showed an improvement in reaction time when seated on the ball. There was no statistically significant difference noted between seating options for students without ADHD. Accuracy was not noted to be worse for students with ADHD than for students without when identifying the target stimulus, yet the reaction time was significantly slower for students with ADHD. The change in reaction time was so significant for these children that it almost eliminated any discernable difference between the non-diagnosed and the ADHD group. In other words, the therapy ball appeared to level the field for students with ADHD for attention and concentration. The authors suggest additional investigation of other sensory integration therapies as it relates to impacting cognitive processes. They also point out that this study supports an immediate positive effect from sitting on the ball, but pose the question about whether this effect can be sustained by continued ball sitting.

Continued concerns throughout the research focuses on how to improve in-seat performance, as students may need to sit for five hours during a normal school day (Merril, 2017; Kennedy, 2017). In one recent article on the topic, researchers examined how dynamic seating options affected classroom performance of 15 students with ASD (Matin, 2017). The study used video recording over the course of 9 weeks to compare the performance of preschool-aged children sitting on typical chairs with children sitting on therapy balls and Disc 'O' Sit air cushions. They assessed how the children "oriented" towards appropriate classroom activity (on-task behavior) and the amount of contact they maintained with the chair during classroom time (in-seat behavior) in each sitting condition.

A study addressing the mixed versus non-mixed peer group issue was published in 2016 by Mead et al. where comparisons were made between three different classes. The first class always sat on stability balls during instructional class time. The next class participated in a variety of different activities during instruction. The third class did not engage in physical activity, or sat, during instruction. Data from several benchmark assessments taken throughout the year were analyzed to determine if there were significant differences in the achievement or improvement of the classes over the course of the school year. The results revealed that the class that always sat on stability balls during the instructional time demonstrated a statistically significant overall improvement from the beginning to the end of the school year. There are different findings in different studies. Another theory behind the mixed results suggested by Fedewa et al. (2014) is the lack of statistical significance as a result of a small number of students who are being measured, monitored, and observed. They also suggested the concern about consistent data collection using a consistent rubric.

Continuing the extension of her studies, Fedewa co-authored a different study that supports the lack of known negative impact of using stability balls for students with attention problems (Erwin, Fedewa, Ahn, & Thornton, 2016). That study established that stability balls have not been shown to be a distraction for children with attention problems when implemented in the classroom setting.

Fedewa et al. (2014) completed a review of the relevant literature on the impact of flexible seating with the stability ball, including a 2011 study conducted by Fedewa and Erwin. Their review of the literature reviewed the research on the effects of sitting on stability balls for students with and without disabilities. They reviewed the positive impact noted for students who have diagnoses like ADHD or ASD, and reveal that in their studies, statistical significance is not reached for positive impact using stability balls with populations that included students with and without confirmed disabilities (2014). Although, research has shown that with stability ball use there are noted improvements during task completion and instruction attentiveness for students who have difficulty remaining in their seats, completing tasks, or attending during instruction (Fedewa et al., 2014; Goodmon, et al., 2014; Hanscom, 2014; Hartanto, et al., 2015; Mead, Scibora, Gardner, & Dunn, 2016; Sarver et al., 2015; Wittberg, Cottrell, Davis, and Northrup, 2010; Rapport et al., 2009). The research on the therapy ball also included support for use of therapy balls by students with a variety of special needs, including sensory processing, ASD, and ADHD. The statistical significance was not as strong when studies include mixed populations of students with and without disabilities.

In the study by Goodmon et al. (2014), the research team drew conclusions about the similarity of the behaviors and needs of children with dyslexia as compared to that of children with ADHD, as it related to difficulty with attention, concentration, and written work. They also

noted the rate of comorbidity of students diagnosed as having dyslexia and also ADHD. Given the overlap, their goal was to evaluate both qualitative and quantitative data from a sample of 24 students who were all diagnosed with dyslexia and attended a school for students with dyslexia. Some of the participants also had a comorbid diagnosis of ADHD. The study is unique because it was the first to study the effects of the therapy ball on reading comprehension, and also took qualitative data regarding desirable and undesirable student behavior while using the therapy ball as a chair. The results indicated self-rating of support for therapy balls in the classrooms resulted in endorsement of an increase in desirable behaviors and the decrease in undesirable behaviors while using the therapy ball. Significant effect was reached based on the rating for students wanting to continue to use the therapy ball. The authors discussed the possibility of maturation of the subjects over the course of the study as a possible confounding factor in overall behavior improvements; however, enough supporting evidence was found through the study to rule out maturation as a confounding reason for improvement in behavior. Although behavior improvement was endorsed by the students, there was no therapeutic effect noted for reading comprehension. There was adequate discussion about the floor and ceiling of the rating, and the differences in the baseline and the ability to improve statistically based on the proximity of the baseline to the ceiling. The method is similar to other studies comparing classes to one another for therapeutic effects in that classes information was compared at the end of the treatment.

In an attempt to increase the amount of information regarding the effect of the stability ball on student outcomes, Fedewa et al. (2016) took another look through the research on the impact of the stability ball. The focus of this study was the impact of randomized assignment of stability ball seating on-task behavior, academic achievement, and discipline referrals. The study looked at two second grade classrooms, and utilized over 80 students balanced by gender. The

method was a momentary time sample taken at different intervals throughout the school year. Other data included discipline referrals. The researchers implemented a two-week *washout period* for the students to acclimate to the ball, and the researchers to become reliable with each other collecting data. Baseline data were also collected during the washout period. Results of the study suggested no significant impact on achievement or on-task behavior. Another interesting note in this study that seems to be a thread among studies and repeated, was the suspicion that non-disabled students may not significantly benefit the way that disabled students are shown to benefit. In other words, students with ASD or ADHD tend to show much more significant improvement with stability balls in other research studies. A study with mixed peer group may not show these results because students who already do pretty well, continue to do pretty well, and disabled students are a small percentage of the overall population. Implications for further research might be looking at improvement between matched groups of students with and without disabilities.

One of the few published studies on students without disabilities and the impact of using the stability ball as a seating option was completed using college students (Kilbourne, 2009). The researcher did not measure academic success, but rather attitudes and perceptions about ball use and its effect on their performance. The author shared that students' questionnaire responses gave clear endorsement of the ball as an option for seating during a lecture class. Students endorsed at a high level positive impact on attention, note takings, engagement in discussions in the classroom, and test taking. Out of 51 students surveyed, 50 reported that they would choose the therapy ball as their seat if given the choice.

Haranto et al. (2005) findings suggested that accuracy in students who have ADHD may be enhanced by more intense activity. Another way of thinking about it is to consider that when

a child with ADHD is using more cognitive resources, he is more likely to be engaging in physical activity. Similarly, other researchers noted that increased use of the vestibular and the proprioceptive systems while seated on the therapy ball seemed to improve the on-task behaviors significantly over that noted while seated in standard classroom chairs (Burgoyne & Ketchum, 2015).

In 2017, Matin et al. published a study that compared three different types of active seating for students with identified sensory processing disabilities. This study was completed in 2014, and utilized video recordings of behavior in the method. Fifteen students with ASD were studied in a multiple treatments design and measured for sitting time and on-task behaviors. Symptoms commonly associated with ASD were also rated at the beginning and at the end of the eight-week treatment period. The treatments included classroom chairs, wobble seat air cushions, and stability balls. The study focused on the efficacy of each treatment, specifically thinking about space for those items in a classroom. Results of the study showed therapeutic results for using the cushion and the ball over traditional seating. Depending on the sensory needs of the child, one type of seating was preferred over the other for on-task behavior; however, the use of the ball produced the most significant impact on staying seated. The sample size was small, but has implications for further study. The authors discussed the importance of the proprioceptive and vestibular systems lending additional support for the idea that movement is important for students with special needs in increasing attention and task completion. This study utilized video recordings of behavior in the method. Fifteen students with ASD were studied in a multiple treatments design and measured for sitting time and on-task behaviors. Symptoms commonly associated with ASD were also rated at the beginning and at the end of the eight-week treatment protocol. The treatments included classroom chairs, wobble seat air

cushions, and stability balls. When considering seating intervention options, the Matin study (2014) was looking at the efficacy of each treatment specifically thinking about space for those items in a classroom. Results of the study showed therapeutic results for using the cushion and the ball over traditional seating. Depending on the sensory needs of the child, one therapeutic seating was preferred over the other for on-task behavior; however, the use of the ball produced the most significant impact on staying seated. The sample size for this study was a small, but had implications for further investigation, possibly on a larger scale.

**Summaries and critiques of previous studies**

There have been no published studies to date that focus singularly on the effects of the wobble stool as they relate to academic task completion or accuracy of work completed. There are several master's level theses that touch on the topic of wobble stools, but they remain unpublished, and currently unsupported by additional published studies of greater magnitude.

It is important to note that all the studies on the effects of the therapy ball completed prior to the 2014 study by Goodmon et al., were plagued by small sample sizing and lack of any quantitative data to support the anecdotes and the teacher reports about the efficacy of therapy balls (Goodmon et al., 2014). The Fedewa and Erwin study in 2011 was one exception in that they reported hyperactivity scores from a rating scale that was administered as part of their study. The qualitative nature of the information in the previous studies lacked any quantitative backing or assessment of significance. Goodmon et al. report is it difficult to determine if the reported improvements in…

> …attention, learning, behavior, and social validity were of any practical significance. Also, because the studies did not include more than one sample, there is no way to discern if the improvements would generalize to other children with similar attention

problems or to other classrooms with different student dynamics and teaching styles. (2011, p. 125)

Group composition was another concern in the studies prior to 2014. Two studies (Schilling & Schwartz, 2004; Schilling et al., 2003) limited their population samples to include only students with formal diagnoses of ADHD, while two other studies limited their population to only include students with ASD (El -Sayed et al., 2016; Goodmon et al., 2014). Other studies used mixed samples of students who had formal diagnoses with those who did not, or did not differentiate the students in the population at all.

The methods used in previous studies began with anecdotal data in the studies conducted prior to 2011, with the exception of the 2003 study (Schilling et al., 2003) that quantified ADHD symptom expression through an ADHD rating scale (Fedewa & Erwin, 2011). Researchers building on the ideas and data collected through these important studies, began investigations that included additional methods like time sample observations, EEG, legible words produced in a writing sample, and observations of in-seat/out of seat behavior. There were additional studies that included scores on high stakes and benchmark testing to suggest whether or not the ball was an effective alternative seating. Researchers compared students with sensory processing and attention issues to students without for behaviors both on the ball, and seated in standard chairs. There have been comparisons made of student groups, as well as notations of individual student progress.

One of the lingering questions after reviewing the research continues to be if the therapy ball is effective for students who are not identified as having sensory or attentional difficulties. There has been plenty of evidence to suggest the therapy ball is an effective seating intervention for students who have these challenges. When populations are combined, the effect size tends to

be lower than when students with disabilities are separated from those without disabilities. The research has given support for the idea that students with disabilities improve more than students without disabilities, and in some cases the students with disabilities come to baseline obtained by students without disabilities by using the therapy ball (Wu et al., 2012). An interesting research finding has begun to emerge in the literature, and has some impact for further consideration. In the study by Fedewa et al. (2014) they noted the suspicion that students identified as not having a disability may not significantly benefit the way that students who are identified as having a disability are shown to benefit from stability ball seating. In other words, students with ASD or ADHD tend to show much more significant improvement with stability balls. A study including a mixed peer group may not show these results. One theory posited by the authors is that students who already do pretty well, continue to do pretty well. Another theory is that students with disabilities are a small percentage of the overall population, and therefore the impact statistically may be masked when viewing student data collectively. Yet there is some evidence that dynamic seating options could benefit any student, not just students identified as having sensory or attentional challenges.

**Analysis of Theories that Related to the Study**

There is a large body of literature to support the link between movement and achievement (Jensen, 2003; Wittberg, Cottrell, Davis, and Northrup, 2010). The Wittberg study demonstrated a link between movement and achievement, but had as its main focus the threshold of physical fitness for optimal positive academic impact. They investigated whether better physical stamina was positively correlated to higher academic performance. Although the relationship between physical activity and achievement was investigated, that literature does not address activity during instruction and its impact on positive academic outcomes.

Sarver et al. (2015) completed a small study of 29 boys with ADHD and 23 boys without ADHD. The results suggest that children with ADHD need to squirm to learn, an idea that has been echoed through research in the area of occupational therapy, and used to make recommendations for need to fidget (Gregory, 2017; Hanscom, 2014). Gregory addresses one of the latest innovations claiming to improve attention and concentration in students, the fidget spinner. The article cites several known researchers, including Rapport and Sweitzer, who say that the spinner is doing all the work while the child is likely distracted by watching it spin. There is essentially no benefit to holding a spinning object. The idea behind a fidget is for the student to move, not so an object they are holding can move. Fidgeting may benefit students with ADHD, but watching an object is not the same as fidgeting. The theory is that many students with ADHD might get better marks if they could do classroom work, tests, and homework while sitting on therapy balls, riding a stationary bicycle, or engaging in some other form of non-disruptive physical activity (Koffler, Rappaport, & Alderson, 2008; Rappaport et al., 2009; Reichenbach, 1992). Sarver et al. (2015) suggested that students with ADHD did better the more they moved while students without ADHD did more poorly. Children with ADHD have to move to maintain alertness. This has implications for interventions with students both with and without ADHD for classroom accommodations and work space considerations. This idea supports the notion that active seating using any of a variety of available active seating options could yield similar outcomes.

The proprioceptive and vestibular systems were referenced often, and provide additional support for the idea that movement is important in increasing attention and task completion by providing sensory input to students with sensory processing needs (Burgoyne, & Ketcham, 2016; Fedewa & Erwin, 2011; Hanscom, 2014; Haranto, 2014). How this relates to the impact of

student improvement on academic tasks remains unclear, as does the level of sensory feedback needed for students who have sensory processing differences as compared to the needs of students who do not have those differences.

**Unresolved Questions from the Previous Research**

One of the leading unresolved issues is the difference or lack of difference when populations of all students are measured as compared to when students with disabilities are evaluated. One of the possible reasons for lack of statistical significance is that students who are doing well continue to do well, and therefore would not show a significant gain (Fedewa et al., 2016). Another possible explanation is that students with disabilities (SWD) make up approximately 13% of the total population. In a random sample with all factors being equal, there is still only a small portion of the sample size statistically represented. SWD have been the population where the most impact has been shown.

A few studies have shown impact with heterogenous sample groups. None of the studies have compared students to themselves both on and off the treatment protocol using work samples as the measurement. None of the other studies have done a comparison of total items completed to total items expected, nor a comparison of total items accurate out of total items attempted. There are gaps in the data collected thus far, as well as a lack of information regarding other flexible seating options outside of the therapy ball. There are to date no formal studies on the use of active learning stools, or the wobble stool. The therapy ball has been a popular and affordable choice in the classroom, as it allows children to move and bounce while still seated at their desk, yet so much of the initial studies prior to 2014 were mainly surveys of teacher, student, and parent perceptions rather than hard data regarding positive student outcomes. The previous studies lacked reporting quantitative information about number of office or discipline

referrals, or positive or negative change scores on formative, summative, or high stakes assessments.

**Ways the Proposed Study Seeks to Fill the Research Gap**

This study was designed to take data on a relatively new flexible seating option that has some similarity to the therapy ball. One difference in the therapy ball and the wobble stool, is that students cannot bounce up and down on the wobble stool. Other movement opportunities are similar in that a student may rock, wiggle, and shift to any angle, and the wobble stool has no back, which requires the engagement of the core muscle groups as well as leg muscle groups to maintain balance and posture. The wobble stool is considered an active or dynamic seating apparatus similar to the therapy ball. This study will help identify if other active seating options show similar results to those noted in studies on the effects of the therapy ball, and will add to the literature on the effects of a dynamic seating option on students who are not identified as having sensory processing or executive functioning challenges.

This study will address the issue of group versus individual growth or maintenance of success while using the wobble stool. Each student will have the opportunity to use a wobble stool intermittently throughout the day for independent work completion. Samples will be taken to compare work on the wobble to work off the wobble. Total scores will be tallied for each student and compared, as well as a total group score for work completed on the wobble versus that completed using regular seating.

This study will not address attention and concentration, nor will it attempt to differentiate among populations of students with special needs such as disorders of executive functioning, or disorders with sensory processing, including but not limited to ADHD and ASD.

**Summary**

The wobble chair is a relatively new flexible seating option gaining momentum and advertising as an active seating option for adults and children. One brand, the hokki stool, seems to be most widely recognized. This study will focus on the intermittent use of the wobble chair and its relationship to student work completion and accuracy. Because of its similarity to the therapy ball in allowing freedom of movement, and its stability while in use, the wobble chair could be a reasonable alternative to standard classroom seating offering students the opportunity to engage their physical and cognitive pathways through their learning process. Research on the impact of using the therapy ball, as well as the impact of movement on achievement, cognitive processing, attention, and movement have been completed with mixed results based on populations measured. There is some disagreement between studies about the overall impact of therapy ball use on student academic outcomes for the general population. Most importantly, there has been no evidence at this time to say student use of a therapy ball has a negative impact on student outcomes (Erwin et al., 2016). There is, however, some disagreement as to whether students without executive functioning disorders or Sensory Processing Disorder (SPD) reap any real discernable benefit from flexible seating using the therapy ball (Fedewa et al., 2016). The argument from Fedewa and colleagues is the most benefit of movement during instruction or work tasks seems to be consistently found for the population of students identified or suspected of having some type of executive function disorder (Fedewa et al. 2011; Erwin et al., 2016) including those with similar or comorbid dyslexia (Goodmon et al., 2014). There has also been research to support use of the ball with students with sensory integration disorders and ASD. When comparing the impact of the therapy ball to the seating option of an inflatable seat

cushion, results were noted in favor of the therapy ball over the cushion for both attention and task completion (Matin et al., 2017).

The idea of dynamic, or active, seating as a viable strategy to impact student outcomes has been supported through the research on the impact of the exercise of stability ball. Additional options for flexible seating are popping up in education literature and online resources (Carter, 2017; Guardino, & Fullerton, 2010; Merrill, 2017; Mayo Alumni, 2006). The notion that the classroom environment plays a role in children's attention and concentration has been proved through the literature, and includes the impact of seating mechanism on the performance of the child. The wobble stool is a relatively new dynamic seating option, and to date there is no published research on its impact on student outcomes. As teachers and school leaders seek to find new ways to structure the classroom environment, and modify their classrooms into learning centers that match student needs (Merrill, 2017), it is preferable that information about the effectiveness of some of the seating options help guide school teams in budgeting and planning their design and implementation.

# Chapter 3: Methodology

## Introduction

The study involved a group of teachers and students from a randomized sample of volunteers. The Institutional Review Board (IRB) of Carson-Newman University approved all procedures for this study. Teacher and parent consent were all obtained. Child assent to using alternative seating was gained by the teacher. Teacher volunteers were sought using social media blasts and contacts with surrounding school districts. Initial requests for teacher volunteers attempted to identify teachers and schools that use the wobble stool in classrooms. Letters of invitation, which also explained the study, were sent to teachers in participating school districts. Subsequently, information regarding the study, along with a permission to participate, was provided to the students in the classroom. Each teacher participant was encouraged to involve as many participants as was manageable, which was dependent upon the number of wobble stools available in each classroom. Signed student participation forms were collected and maintained for reference.

Work samples were collected from the identified students for comparison of both accuracy and amount of work completed. Work samples were gathered throughout the sampling period. Equal sampling for both the wobble stool use and traditional seating was requested. Comparisons were made at the end of data collection period regarding the total amount of work completed by the study group, as well as the accuracy of the work completed by the same group of students when they used the wobble stool as opposed to when they did not use the wobble stool.

## Population and Sample

There were 13 student participants in this study, in grades 1 - 4. These participants attended either traditional public schools or a private school. Efforts were made to balance the number of male and female participants. Users of flexible seating were polled through a social media blast. Teachers who had interest in using, or currently use wobble stools, as well as those who know of other teachers who use the wobble stool in their classrooms were asked to contact the researcher to help provide clarity of how many local districts used flexible options. This allowed the researcher to minimize the possible sample size. Potential teachers participants were contacted through the channels outlined in their district policy. One school district in East Tennessee agreed to participate, and one private school in St. Louis agreed to participate. Final district and school participation was granted through written agreement. The researcher followed the school system human subjects participation process for each district and school.

## Description of Instruments

The measure selected is independent seat work. Two pieces of work will be captured via free phone scanner app each day for each student. Seatwork can be any independent work that has a time-limit, and is not part of a group collaborative. It could include any student work such as a spelling test, math work, writing or journal sample, a work sheet, or any other non-group paper/pencil, or cut-sort-paste assignment.

## Description of Materials

**Wobble stool.** A wobble stool can be any stool with a convex bottom, stem, and seat bottom. The wobble stool can also be known by as wobble chair, hokki stool, or active seating stool. The wobble stool was the appropriate size for the student using it. Wobble stools come in

a variety of heights based on student height, and age, and some are adjustable. The type of stool, or brand was inconsequential. Any stool that met the definitions of a wobble stool was accepted.

**Standard chair.** A standard chair is one that is typically found in the classroom, and includes chairs with a hard bottom, four equally placed metal or wooden legs, and has back support (Kennedy, 2017). Standard chairs in a classroom are assumed to be sized appropriately for the student's age and grade (Cotton, O'Connell, Palmer, & Rutland, 2002), although there is considerable range in the height and weight of children in the school setting. Standard chairs could also include the type that have *tablet arms* where students slide into them.

**Research Procedures and Time Period of the Study**

At the beginning of the study, a period of one week of adjustment or acclimation was given for students to become familiar with the intermittent use of the wobble stool. A similar procedure was recommended in other studies (Fedewa, Davis, & Ahn, 2016). Baseline data were collected prior to each student participant using the wobble stool. Teacher participants were encouraged to permit students to used wobble stools at their own discretion at various times or for various assignments. Each student completed a variety of assignments on the wobble stool over the course of the data collection period as well as assignments using their standard classroom seating.

Each day during the data collection window the student completed one piece of independent work while seated on the wobble stool, and one piece of independent work while using traditional classroom seating that were collected via photo scanning with a mobile device. At the end of the work time allotted by the teacher for the class, the teacher coded each work sample with the either a "W" for wobble stool work, or a "NW" for work completed on a traditional chair. The teacher ensured the date was on each sample. Each work sample was

scanned at the end of the time allotted to the class via free smart device application, which is similar to taking a picture. Subsequently, each scan was sent directly to the researcher electronically. Use of the scanning application allowed student work samples to remain in the classroom, and allowed their uninterrupted availability for immediate feedback between teacher and student participants, thus maintaining the reciprocal process of learning. The teacher participant was able to provide the work back to the student for corrections or completion right away, as well as to provide feedback on student skill acquisition. Work samples were submitted daily by the participating teachers for each student participant. Treatment and non-treatment work samples were collected daily for each student in the study for a time period of two consecutive weeks in March of the 2017-2018 school year. This collection during this window yielded approximately 52 work samples for each treatment condition for a total of 104 work samples. All data were compiled for a total number of items completed, as well as total items correct out of the total number possible. Student data were utilized regardless of the number of days a student participated. Data were discarded for a student if there were unequal numbers of samples for wobble seat and non-wobble seat work. In these cases, the last data received was discarded if there were too many samples for that student in a treatment condition.

**How the Data were Analyzed to Respond to the Research Question**

Data were anonymized outside the collection setting by the researcher. Each student was assigned a participant number. Data were analyzed using a simple T-test for pre- and post-treatment condition for the group as a whole and for each gender. Individual work samples were combined into group data for the wobble stool treatment group and for the traditional seating treatment group. For each treatment group the total number of items completed was represented in a ratio over the total number of items possible. Similarly, the total number of items correct

was represented in a ratio over the total number of items possible. The two ratios were compared for treatment and non-treatment groups regarding the amount of work completed and for the amount of work correctly completed. A T-test was conducted for the pre- and post-treatment conditions. This is a dependent, or within-groups, design which simply means that the subjects selected from the general school population are in both conditions of the study (wobble stool and standard chair). This design limits the amount of variation due to extraneous factors, thereby increasing the power of the study. Subjects are matched because they participate in both conditions, allowing for direct comparison of data from one condition to the other. The paired t-test is one tailed due to the nature of the prediction in the hypothesis. A one-tailed test is used when the hypothesis is directional. In this case, the hypothesis states there will be an increase in performance using the wobble stool. A two-tailed test would have been appropriate had the hypothesis been that there would be a difference without the prediction of performance increasing or decreasing. The individual data were also similarly reviewed for possible trends, as well as investigated for differences given the demographic factor of gender. Both physical and electronic student data were kept for six months after the study, then destroyed or erased.

# Chapter 4: Results of the Data Analysis

## Introduction

This chapter reviews the results of the investigation into the efficacy of the wobble stool as compared to the standard classroom chair as they relate to student work completion and work accuracy. Two hypotheses were suggested for this study. The first is that there would be an increase in the accuracy, or number of items completed correctly, of independent seatwork while using the wobble stool. The second is that there would be an increase in the amount of work completed on the wobble stool as compared to that completed while using standard classroom chairs. Research questions, descriptive statistics, and data analysis for both research questions are presented in this chapter. Descriptive statistics are presented in Table 4.1, and data analysis for each question is presented in Table 4.2 through Table 4.7. Finally, a summary of data analysis will be presented.

## Descriptive Statistics

Three schools participated in this study. Two schools were public elementary schools located in East Tennessee serving students in grades K – 5. The other school is a private school located in St. Louis serving students in grades K – 8. Four teachers were able to provide data on a total of thirteen students. Public school student participants totaled 8, with the remaining 5 student participants coming from private school. Of the participating students 7 are male, and 6 are female. Teachers provided a total of 108 data samples for the thirteen students. Of those samples, 4 were discarded due to lack of matching data for the other condition. In other words, too many samples for one condition were submitted and could not be matched to the other condition. Samples that were the last received were discarded to maintain the integrity of the data collection process. A total of 104 data samples were used for analysis, with 52 samples of

student work on the wobble stool, and 52 samples of student work while seated in a standard classroom chair. Equal numbers of samples were collected for each student for each condition.

Table 4.1

*Descriptive Statistics for Student Participants*

| Category | Descriptor | N Students | % Students | N Samples | % Samples |
|---|---|---|---|---|---|
| Gender | Male | 7 | 54% | 58 | 56% |
| | Female | 6 | 46% | 46 | 44% |
| Education setting | Public | 8 | 62% | 60 | 58% |
| | Private | 5 | 38% | 44 | 42% |

*Note: Student n = 13 and Work Sample n = 104*

Of the total students participating 54% were male and 46% were female, with 62% of the student participants enrolled in public elementary school, and 38% enrolled in a private K – 8 school. The total percent of samples coming from the private school setting totaled 42%, with the remaining 58% coming from students in public school. Male participants accounted for 56% of the population, and female participants accounted for 44% of the sample population.

## Research Results

**Hypothesis One.** The first hypothesis was that there would be improvement in overall student academic outcome, specifically noted by an increase in the accuracy of work completed while using the wobble stool as compared to that completed using regular classroom seating. The second hypothesis suggested that there would be an increase in overall work completion while using the wobble stool as compared to the amount of work completed while using a

standard classroom chair. The null hypothesis for both conditions was that there would be no change in the amount of work completed or the accuracy based on the seating used.

$H_1$ - Intermittent use of the wobble stool during independent seat work results in an increase in the accuracy of student work completed.

$H_0$ - No cumulative change will occur in either accuracy or quantity of student independent work as a result of using the wobble stool as a seating alternative during independent work.

The first question addressed student work accuracy, or the number of items correct out of the total number of items the student completed in the allotted time. Writing samples were scored using a rubric. The student scores were converted to a decimal to represent the ratio of items correct over total items completed. Ratios in decimal form were averaged for the conditions of "Wobble stool work" and "Non-wobble stool work," and then analyzed using a one-tailed Paired T-test. The one-tail option is used because the prediction in the hypothesis is directional, in that scores are predicted to increase by using the wobble stool. While using the using the wobble stool, students earned 1176 out of a possible 1278 points on independent seatwork. This revealed that students using a wobble stool based on 52 samples earned 90.36% correct. While completing work using a regular classroom chair, based on 52 work samples, participants earned 957 out of a possible 1111 points, resulting in 87.16% correct for the work attempted. For the entire n = 104 the t-statistic was not significant at the .05 alpha critical level $t(51) = 1.078$, $p = .1428$; therefore, there is failure to reject the null hypothesis. These results fall short of meeting the critical alpha level. These results suggest that approximately 14% of the difference noted in this study are likely due to chance rather than an effect of using the wobble

stool. For this difference in scores to be considered clinically significant, the p-value would need to be at or closer to .05. These findings are summarized in table 4.2 below.

Table 4.2

*Total Percentage of Work Completed by Subjects*

t-Test: Paired Two Sample for Means

| *Wobble Percentage* | | *NW Percentage* |
|---|---|---|
| Mean | 0.903368642 | 0.87163442 |
| Variance | 0.026327538 | 0.025090198 |
| Observations | 52 | 52 |
| Pearson Correlation | 0.124786045 | |
| Hypothesized Mean Difference | 0 | |
| Df | 51 | |
| t Stat | 1.078715615 | |
| P(T<=t) one-tail | 0.142895046 | |
| t Critical one-tail | 1.67528495 | |

When the data was divided into groups by gender, the results looked a little different. Based on an n = 46 for the number of samples completed by female participants, there was statistical significance found at the .06 level. For the entire n = 46 the t-statistic was not significant at the .05 alpha critical level t(23) = 1.7171, p = .0630. Although there is failure to reject the null hypothesis based on the .05 alpha critical level, the difference noted for the female participants nears the .05 critical alpha level with p = .06. This suggests that approximately 6% of the difference noted in the female sample is accounted for by chance or other variables, and 94% of the difference in the female sample could be accounted for by use of the wobble stool. Results are contained in Table 4.3 below. The female students completed 459 items correct out of a possible 503 items while using the wobble stool, resulting in a 91.25% correct for all items attempted. While using standard seating the female participants completed 468 out of a possible

572 total items correct. This revealed that the female students only completed 81.81% of their attempted work correctly while seated in standard chairs.

Table 4.3

*Percent of Work Completed Correctly by Female Subjects*

Female Subjects — t-Test: Paired Two Sample for Means

| | *Wobble Percentage* | *NW Percentage* |
|---|---|---|
| Mean | 0.903859733 | 0.822469481 |
| Variance | 0.017755316 | 0.035231324 |
| Observations | 23 | 23 |
| Pearson Correlation | -0.145264064 | |
| Hypothesized Mean Difference | 0 | |
| Df | 22 | |
| t Stat | 1.590182535 | |
| P(T<=t) one-tail | 0.063031118 | |
| t Critical one-tail | 1.717144374 | |

When analyzed separately, male participants accurately completed 717 out of a possible 775 items while using the wobble stool to complete independent work. This translates into 92.5% of the work completed correctly. They complete correctly 489 out of 539 items while using standard classroom chairs. This is an accuracy rate of 90.7 % for the work samples collected. The male data set was further analyzed by using the one-tailed Paired t-test. Of the 58 total data samples from the male participants, the t-statistic was not significant at the .05 alpha critical level $t(28) = .2339$, $p = .4083$. For the group of male participants, almost half the difference in scores is accounted for by extraneous factors and could not be attributed to the effects of the wobble stool. These results are captured in Table 4.4 below.

Table 4.4

*Percent of Work Completed Correctly by Male Subjects*

Male Subjects — t-Test: Paired Two Sample for Means

| | *Wobble % Correct* | *Non Wobble % Correct* |
|---|---|---|
| Mean | 0.902979157 | 0.910627304 |
| Variance | 0.03400277 | 0.014457954 |
| Observations | 29 | 29 |
| Pearson Correlation | 0.393818175 | |
| Hypothesized Mean Difference | 0 | |
| Df | 28 | |
| t Stat | -0.233935017 | |
| P(T<=t) one-tail | 0.40836873 | |
| t Critical one-tail | 1.701130934 | |

**Hypothesis Two.** Similar to the first hypothesis, the second hypothesis also predicted an increase in performance. This time the increase was predicted for performance on the wobble stool for the amount of work completed as measured by the number of items completed out of the total possible number of items. The null hypothesis is that there will be no change in the amount of work completed by students when using the wobble chair as compared to how much work is completed while seated in a standard classroom chair.

$H_2$ - Intermittent use of the wobble stool during independent seat work results in an increase in the amount of student work completed.

$H_0$ - No cumulative change will occur in quantity of student independent work as a result of using the wobble stool as a seating alternative during independent work.

Just as in the first condition, student scores were converted to a decimal to represent the ratio of items completed over total items possible. Ratios in decimal form were averaged for the conditions of "Wobble stool work" and "Non-wobble stool work," and then analyzed using a

one-tailed Paired T-test. Again, use of the one-tail option was selected because the prediction in the hypothesis is directional. Again, the scores were predicted to increase when using the wobble stool. Based on 52 samples of student work while using the using the wobble stool, students completed 1267 out of a possible 1285 items on independent seatwork. This revealed that students using a wobble stool based on 52 samples completed 98.59% of their assigned work. Results revealed that when using a regular classroom chair, based on 52 work samples, participants completed 1112 out of a possible 1134 items for 98.05% work completed. The t-statistic was not significant at the .05 alpha critical level $t(51) = 1.031$, $p = .1537$. There is failure to reject the null hypothesis in this case also. These results fall short of meeting the critical alpha level. These findings are summarized in table 4.5 below.

Table 4.5

*Total Percent of Work Completed by Subjects*

t-Test: Paired Two Sample for Means

| | *Wobble %Correct* | *Non Wobble %Correct* |
|---|---|---|
| Mean | 0.988548951 | 0.978376 |
| Variance | 0.00246029 | 0.003914 |
| Observations | 52 | 52 |
| Pearson Correlation | 0.210875851 | |
| Hypothesized Mean Difference | 0 | |
| Df | 51 | |
| t Stat | 1.030717481 | |
| P(T<=t) one-tail | 0.153768381 | |
| t Critical one-tail | 1.67528495 | |

This condition can also be analyzed by separating the population by gender then completing a paired t-test for both of the groups, male and female. When examining the amount of work completed by the female participants, initial evaluation reveals that out of a possible 517

items, the female group completed 503 items while using the wobble stool. This resulted in 97.29% total work completed for the female group while seated on the wobble stool. Conversely, when using standard school seating, the female group completed 573 items out of a possible 577 items for 99.31% rate of completion. When a paired t-test was run comparing the difference between the amount of work completed on the wobble stool and that completed using standard school chairs, the difference was not significant at the .05 alpha clinical level t(28) = -0.4845, p = .31. Not only was the prediction not significant at the .05 alpha critical level, but the result was skewed in the opposite direction of the prediction. See Table 4.6.

Table 4.6

*Percent of Work Completed for Female Subjects*

Girl
Wobble

% Complete

t-Test: Paired Two Sample for Means

| | *Wobble % Complete* | *Non-Wobble Percent Complete* |
|---|---|---|
| Mean | 0.984980237 | 0.991666667 |
| Variance | 0.00384567 | 0.000839646 |
| Observations | 23 | 23 |
| Pearson Correlation | 0.085276458 | |
| Hypothesized Mean Difference | 0 | |
| df | 22 | |
| t Stat | -0.484594536 | |
| P(T<=t) one-tail | 0.316376879 | |
| t Critical one-tail | 1.717144374 | |

When the data for the male group was analyzed (n = 58 samples) using the t-test, the .05 critical alpha level was met, t(28) = 1.7306, p = .04, suggesting that there is a statistically significant improvement in the amount of work completed for the male group when they used the wobble stool. Results of the data analysis are summarized in Table 4.7. The male group completed a total of 539 out of 557 total items using standard classroom seating for a total of

97% of the work completed that was assigned. While using the wobble stool the male group completed 764 out of 768 possible items for the work they were assigned resulting in a completion rate of 99.5%.

Table 4.7

*Percent of Work Completed by Male Subjects*

Male
Wobble

Percent Completed

t-Test: Paired Two Sample for Means

| | *Wobble % Complete* | *Non Wobble % Complete* |
|---|---|---|
| Mean | 0.99137931 | 0.967834847 |
| Variance | 0.001440887 | 0.006209331 |
| Observations | 29 | 29 |
| Pearson Correlation | 0.381587303 | |
| Hypothesized Mean Difference | 0 | |
| Df | 28 | |
| t Stat | 1.730627852 | |
| P(T<=t) one-tail | 0.047263331 | |

**Summary**

This study design included the same group of students using both seating options for comparison of independent seat work samples collected over the course of a 2-week period in March 2018. Although not statistically significant, students completed 3% more items correctly while using the wobble stool in the sampling. Student performance during this sampling revealed very little change in the amount of work completed, changing from 98.05% while using the regular classroom chair to 98.59% while using the wobble stool. The null hypothesis could not be rejected for either hypothesis based on the sample collected. The results of the data analysis revealed no significant difference between the differences in the amount of work completed correctly on the wobble stool or the total amount of work completed on the wobble

stool when compared to work completed using standard classroom seating when the entire data set was analyzed.

Within these results it was surprising that the female subgroup completed the most items correct sitting on the wobble chair, but completed the most items while using standard classroom chairs. Conversely, the male group completed more work while using the wobble stools at a statistically significant level. The difference in the amount of work correctly completed by the male participants was statistically insignificant, with nearly half the variance accounted for by chance. Although there was no significant difference for the male group in the items correct, they did show a statistically meaningful improvement in the overall amount of work they completed.

# Chapter 5: Conclusions, Implications, and Recommendations

## Introduction

This quantitative study was designed to examine the benefit of using active seating in the classroom as an alternative to standard classroom seating. Specifically, this study design was based on comparison of multiple student work samples from both seating conditions. Work samples were coded for number of items completed correctly, and also total number of items completed. Work samples were sent to the researcher using a scanning application for mobile devices, then coded for comparison and analysis using both descriptive statistics and a one-tailed, paired t-test.

The questions driving this inquiry stem from new trends in education, including the *flipped classroom* and *flexible seating* (Merrill, 2017). Many popular education journals and blogs tout the benefits to flexible seating, but further investigation into the research regarding these trends is inconclusive at best. Given the amount of money that is allotted for schools and teachers for classroom supplies, it is reasonable to assume that there is ample data regarding decisions about flipping classrooms or investing in multiple seating options. All educators are responsible for student outcomes regardless of their role. Flexible seating options have been increasing in availability and use among educators (Carter, 2017; Gal, Schreur, & Engel-Yeger, 2010; Kennedy 2016; Kennedy, 2017; Mayo Alumni, 2006). Classroom environment is one factor in student outcomes that has been widely reviewed in the literature (Merritt, 2017). Changes in the structure of the classroom, including type of furnishings, position of the furnishings and access to technology or other materials for learning, and general maneuverability of the classroom for all the students can play an important role in student success.

Another guiding theory behind the query into the effectiveness of active seating using the wobble stool is the research on movement and student achievement (Jensen, 2003; Wittberg, Cottrell, Davis, and Northrup, 2010). Numerous studies on movement and student outcomes have been completed on students with identified disabilities. A body of research exists that suggests students with ADHD might do better on classwork if they had the opportunity to engage in non-disruptive movement like riding a stationary bike or using therapy balls (Koffler, Rappaport, & Alderson, 2008; Rappaport et al., 2009; Reichenbach, 1992). Sarver et al. (2015) suggested that students with ADHD may need to move to learn in a way that is different than students without ADHD. Nearly all the published research on active seating has been conducted on the therapy ball (Erwin et al., 2016; Fedewa et al, 2015), with almost all the research prior to 2011 being based on qualitative data rather than quantitative data. Beginning in 2011, additional effort was made to quantify seated movement and its relationship to student outcome. While some academic outcomes were studies, most of this research was devoted to on attention and concentration, and time on task.

The current study sought to add to the current literature by expanding the research to the wobble stool and by measuring academic daily work products. The wobble stool is a relatively new type of active seating and is very similar to the exercise ball because it allows a student to move while maintaining ability to perform academic tasks. Another purpose of examining the effectiveness of the wobble stool is to contribute to the body of research about this fairly new seating option.

**Conclusions**

This study sought to focus on immediate, daily academic outcomes that could be impacted by seating choices. This study is not designed to evaluate cumulative effects of

alternative seating, nor is it designed to predict outcomes on high stakes testing. This study investigated performance throughout the school day when using active, dynamic seating, as well as static seating. Academic performance, especially improvements in attention and concentration and time on task have been a heavily emphasized in the previous literature on the therapy ball. Previous studies have also measured teacher and student perceptions, as well as outcomes on benchmark or high stakes exams (Mead et al., 2016). This study was primarily dedicated to daily outcomes of student performance. Rather than measuring attention, concentration, or time on task, which theoretically could all lead to improved academic outcomes (Koffler, Rappaport, & Alderson, 2008; Rappaport et al., 2009; Reichenbach, 1992), this study measured daily work using a variety of independent assignments, which were scored for total number of items completed and for total items correct out of the number of items completed.

The first hypothesis stated that there would be an improvement in overall academic performance using the wobble stool. The comparison of the means of the paired sample did not meet the .05 alpha critical level. Rather, with a $t(51) = 1.078$, $p = .14$, the probability that the increase in number of items correct is 14% likely to be due to chance rather than treatment condition. Similar findings were noted for the second hypothesis, which suggested that there would be more work completed by students while using the wobble stool over the amount of work completed while using standard seating. The one-tailed, paired t-test resulted in $t(51) = 1.03$, $p = .15$, which does not meet the .05 alpha critical value for statistical significance. The null hypothesis could not be rejected for either condition. Similar to other research in which the population is not divided into SWDs and non-SWDs, the statistical significance is difficult to achieve even if differences are observed. Dividing the population into male and female participants in this study altered the level of statistical impact. Some changes could be attributed

to a smaller sample size with reduced numbers of work samples, or it could be part of real differences in the sample population. When testing the hypothesis that wobble stool use improves the accuracy of student work, the female population approached statistical significance with a $p = .06$.

The male population exceeded the alpha critical level with $p = .04$ for the hypothesis that stipulated students will complete more work while using the wobble stool. Gender differences were not noted in previous studies. It is reasonable to assume the individual needs of the students, as divided by gender, were met by the conditions of using the wobble stool to a more significant degree than the needs of the whole group.

**Implications and Mitigating Factors**

This study included 13 students from four different classrooms, in three different schools, both public and private. Data were collected from the students by the teachers using a scanning application for mobile devices. This data was subsequently emailed to the researcher. Teachers were asked to provide balanced numbers of *on wobble stool* and *non-wobble stool* assignments. In some instances too many of one treatment condition were submitted, and the last items received were dropped from the pool of samples. An even number of samples for each condition for each subject was necessary to meet the criteria for a within, or matched subjects, design. By comparing individuals to themselves spanning a series of days, the researcher intended to minimize factors that could account for variance.

It was difficult to find school systems willing to participate in the study. Accordingly, finding teachers who currently use the wobble stool was also problematic, which increased the difficulty of securing adequate research participation. This researcher was able to provide three wobble stools to amenable teachers in the research district. Although numerous proposals and

invitations for districts to participate were considered, most districts did not believe that participation in the research would be of enough benefit to warrant participation. Fortunately, contacts within a private school revealed wide usage of wobble stools throughout the school, and this school participated in the study.

This study did not differentiate between students with disabilities (SWDs) and student who are not identified as having disabilities. Literature review noted an emphasis on the impact of active seating using the therapy ball as it relates to outcomes for students with disabilities. These studies mainly focus on students with ADHD or executive functioning disorders and students with sensory processing issues, including ASD. One of the critical arguments detailed in other studies and in meta-analysis suggests students with disabilities have more ground to make up; whereas students who already do well continue to do well. One prevailing idea is that statistical significance is difficult to achieve if the gap between where a subject begins and the maximum performance is small. Studies that utilize an undifferentiated population tended to lack statistical significance. The statistics reported emphasized the magnitude of the impact of active seating on different groups within the student population as opposed to whether active seating is beneficial.

**Summary**

Flexible seating and flipped classrooms are popular with teachers and are documented through many online education magazine and blogs (Merrill, 2017). Utilizing 108 balanced data samples, this study revealed a definite improvement in overall student academic outcomes while using the wobble stool. Although improvements may not have reached the .05 alpha level of clinical significance, there was noted improvement of an average of 3% for questions answered correctly while using the wobble stool. For the amount of work completed, there was a minimal

gain of about .5% by using the wobble stool was noted. Differences among genders exceeded or neared clinical significance in two areas, females with work completed correctly, and males with total amount of work completed.

**Recommendations for Future Research**

This study does not address the root cause of the improvements noted by using active seating. Any changes to the environment of the classroom impact student participation and performance. Whether noted differences in student performance are due to the benefit of the active seating by engaging proprioceptive and vestibular systems, providing activation for areas of the brain that also house learning, or other reasons not mentioned are currently unknown. However, future research could scrutinize these issues. Investigation into the differences in student populations where students with identified disabilities are measured for academic output using a variety of seating options is another area for possible future study.

In an ideal scenario, the sample size of student and teacher participants could be larger with an $n \geq 50$. Student work samples could be collected at different intervals throughout the year rather than over a 2-week period for more consistency with student work patterns and levels of mastery of material. Additional time for data collection could provide samples of daily performance that might demonstrate individual student differences and account for high and low scores. Any increase in the number of data points and subjects provides a better representation of the population being studied.

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# Appendix A

## Parental Consent

# Appendix A: Letter of Parental Consent

Dear Parent:

I am a doctoral candidate student under the direction of Dr. Deborah Hayes in the Department Education at Carson Newman University. I am conducting a research study to investigate the impact of using the wobble stool as an alternative to traditional seating in the classroom setting.

Your child's participation will involve the opportunity for your child to sit on a wobble stool at school during independent work in addition to the use of regular classroom seating. Over a four week period of time, your child's teacher will collect 6 independent work samples each week via scanning app on a mobile device (similar to taking a picture). Three of those samples will be collected after working while seated in the regular desk chair, and the others will be collected when your child uses the wobble stool.

Your participation, as well as that of your child, in this study is voluntary. If you or your child choose not to participate or to withdraw from the study at any time, there will be no penalty. Participation will not affect your child's grade or treatment by the teacher in any way. Your child's teacher is already using alternative seating options in the classroom. Should you elect to discontinue participation, any information already collected will be discarded. The results of the research study may be published, but your child's name will not be used. This research has been approved the University Institutional Review Board.

Although there may be no direct benefit to your child, there is possible benefit of your child's participation. By agreeing to let your child's teacher send me a sample of your child's work, you are providing important information about the effectiveness of one alternative seating option on academic outcomes.

If you have any questions concerning this research study or your child's participation in the study, please call me or email me at LCDohnal@cn.edu or 615-815-5195.
Sincerely,

Linda Cl Dohnal, EdS, NCSP

I give consent for my child _____ to participate in the above study.
Parent's Name (print): _____
Parent's Signature _____ (Date) _____

If you have any questions about your rights as a subject/participant in this research, or if you feel you or your child have been placed at risk, you can contact _____, the Chair of the Human Subjects Committee, Institutional Review Board at (phone number goes here).

# Appendix B

## Student Letter of Assent

# Appendix B: Student Letter of Assent

Student Name: _____ Parent Name: _____

I have been told that my parent gave permission for me to participate, if I want to, in a project about sitting on a different type of stool in class.

I know that I can stop at any time I want, and it will be okay if I want to stop.

Signature and Date: _____

# Appendix C

## Teacher Letter of Consent for Participation

Appendix C: Teacher Letter of Consent for Participation

**Introduction**

- You are being asked to be in a research study to provide information about your students' performance on independent work while using two different seating mechanisms.
- You were selected as a possible participant because you are a teacher who uses or plans to implement use of the wobble stool in your classroom. You may have been identified by a co-worker or administrator.
- We ask that you read this form and ask any questions that you may have before agreeing to be in the study.

**Purpose of Study**

- The purpose of the study is to investigate the impact of using a wobble stool on student work completion and work accuracy.
- Ultimately, this research will be published as part of a dissertation, and possibly published in academic or professional journals.

**Description of the Study Procedures**

- If you agree to be in this study, you will be asked to do the following things: You will be asked to allow the identified student or students (depending on the number you choose) to complete independent work on the wobble stool at different times of the day for a five week period.
- You will allow the student one week to get accustomed to using the wobble stool
- You will select 2 work samples on 3 different days during the remaining 4-week period – one work sample completed on the wobble stool, and one work sample completed in the child's regular chair.
- You will write a "W" on any work completed on the wobble stool, and make sure all work is dated.
- You will scan via free scanning app (adobe is preferred) on any mobile device the work samples as the child completes them, and send them to me through the app.

**Risks/Discomforts of Being in this Study**

- There are no reasonable foreseeable risks to you by participating in the study. There may be unknown risks.

**Benefits of Being in the Study**

- The benefits of participation include establishing a foundation for the informing choice of flexible seating in the classroom.

**Confidentiality**

- This study is anonymous. We will not be collecting or retaining any information about your identity.

- The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file. We will not include any information in any report we may publish that would make it possible to identify you or any of the students participating. At the end of the study all collected data will be destroyed and erased from electronic devices.

**Payments**

- There is no reimbursement for participating in this study.

**Right to Refuse or Withdraw**

- The decision to participate in this study is entirely up to you. You may refuse to take part in the study *at any time* without affecting your relationship with the investigators of this study. Your decision will not result in any loss or benefits to which you are otherwise entitled.

**Right to Ask Questions and Report Concerns**

- You have the right to ask questions about this research study and to have those questions answered by me before, during or after the research. If you have any further questions about the study, at any time feel free to contact me, Linda Dohnal at LCDohnal@cn.edu or by telephone at 615-815-5195. If you like, a summary of the results of the study will be sent to you. If you have any other concerns about your rights as a research participant that have not been answered by the investigators, you may contact _____, Chair of the Carson Newman University Institutional Review Board at _____.

**Consent**

- Your signature below indicates that you have decided to volunteer as a research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigators.

Subject's Name (print): _____

Subject's Signature: _____ Date: _____

Investigator's Signature: _____ Date: _____