The Impact of Dynamic Furniture on Classroom Performance:

A Pilot Study

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Abstract

The purpose of this study was to understand how dynamic classroom furniture may impact classroom performance such as attention, work neatness, and work completion in a second grade general education classroom of 19 students. All students in the classroom were included in this study to understand the implications of environmental modifications on the learning process in general education settings. A descriptive method provided information about the interaction of dynamic furniture on identified learning components. Three different dynamic furniture options were provided: Zuma chairs®, Disc'O'Sits® (inflated seat cushions), and standing desks with the Original FootFidget®. The class was randomly divided into four groups of up to five students. The groups were rotated through the furniture, allowing one week per group with each type of furniture. The Sensory Processing Measure (Parham & Ecker, 2007) was used to screen the sensory processing of students and a daily self-report rubric provided data on attention behaviors and perception of the dynamic furniture options. Data were graphed and visually analyzed for differences in responses to types of furniture. Responses on the rubrics indicate that the different types of furniture impacted different components of learning in a variety of ways. The data from this study indicates that no one type of furniture provides the same effect for all elementary students, but rather that personal characteristics may dictate the best match for focus, work completion, and neatness.

The Impact of Dynamic Furniture on Classroom Performance: A Pilot Study

Current education policy mandates that all students receiving public education in the United States participate and learn in the least restrictive environment (Individuals with Disabilities Education Improvement Act [IDEA], 2004, §300.114). This policy applies to all children and often results in children with disabilities receiving instruction in the general education classroom. These inclusionary practices in schools create challenging learning environments because of the diverse needs of children (Asher, 2010). For the past six years almost 15% of all students in the public schools received services under the provisions of IDEA 2004 (U.S. Department of Education, National Center for Education Statistics, 2010) suggesting that a large number of general education classrooms include a child with a disability. Thus, general education teachers are now faced with the demands of facilitating learning across a wide range of student characteristics, for which they often may not feel adequately prepared (Hemmingsson et al., 2007).

For students receiving services under IDEA 2004, factors impeding success should be addressed. These factors may include teacher influence, personal characteristics of the student, and environmental elements. Previous work suggests that it is easier to modify the environment and the task than the child (Egilson & Traustadottir, 2009); therefore, school-based occupational therapy decisions that focus more extensively on the classroom environment need to be considered. Environmental modifications may be warranted to support the success of these students.

Although the inclusion of all students has long been advocated, few environmental modifications have been made to classrooms to increase the likelihood of success for students

(Egilson & Traustadottir, 2009). The relationship between the student and the classroom environment needs to be better understood (Hemmingsson & Borell, 2001) in order to promote academic performance for all students in inclusive classrooms. One potential area to explore is classroom furniture. The furniture in each classroom should function to facilitate learning while allowing the appropriate level of participation without distractions (Cotton, O'Connell, Palmer, & Rutland, 2002; Knight & Noyles, 1999).

There exists a general lack of research on the various environmental factors, such as classroom furniture, that can influence students' learning (Egilson & Traustadottir, 2009). Previous research noted the complexity of studying the classroom environment due to the interrelated aspects of social, space, and object components (Griswold, 1994). The current study proposes to add to the existing research through focusing on the furniture in the classroom environment and examining how academic performance and attention to task are influenced by alternatives to traditional furniture. The information gained from this study will help occupational therapists and teachers when considering alternative classroom furniture options for intervention with children in the school setting.

Background and Significance

Inclusion

With the shift to inclusive classrooms, teachers are now faced with the task of teaching children with a broad spectrum of learning needs and styles (Hemmingsson, Gustavsson, & Townsend, 2007; Polcyn & Bissell, 2005). Consequently, teachers are expressing a need for more training (Mulligan, 2001). As of 2007, over three-quarters of students with disabilities spent more than half of every day in the general education classroom (U.S. Department of Education, National Center for Education Statistics, 2009), which again illustrates the large

number of classrooms that have a child with a disability. Along with the complexities of teaching a wide range of students, teachers are also held accountable to certain academic outcomes for all children (No Child Left Behind Act [NCLB], 2004), which can result in increased pressure on the teachers. Thus, the task of teaching has become increasingly complex as classrooms are now inclusive and high-stakes testing (Black-Hawkins, 2010) is included to meet requirements of legislation like the NCLB (2004).

The practice of inclusion in general education classrooms is associated with environmental and teaching modifications for the purpose of increased participation in the learning experience. These adaptations can be complex to carry out because each challenge to learning requires different environmental modifications (Gal, Schreur, & Engel-Yeger, 2010). Hemmingsson and Borell (2001) found that a lack of adequate environmental modifications in the general education classroom directly limited the participation of students with disabilities. This finding was validated by Gal and colleagues (2010), who also stated that these environmental modifications are often not enacted due to prevailing attitudes or other factors such as funding. Yet it is through participation in the learning experience that academic achievement occurs, which is one of the expected outcomes of inclusion (Black-Hawkins, 2010). Therefore, a lack of appropriate environmental modifications can limit the learning experience of children with disabilities.

Legislation

Legislation surrounding education has shifted in the past quarter century creating new demands on teachers and supporting services. The push toward inclusion necessitates that teachers are able to address a wider spectrum of needs in the classroom. One of the largest determinants of this shift in the school system was the Education for All Handicapped Act

(EHA) of 1975 (Public Law 94-142). This legislation brought children with disabilities into education settings as compared to services received in segregated medical facilities. Later, the Americans with Disabilities Act of 1990 (ADA) (Public Law 101-336), granted children with disabilities the legal rights to a barrier-free environment. These two laws paved the way for the current education reforms that support the participation and learning of all students in the school.

The latest reauthorization of special education laws emphasizes providing services in the least restrictive environment and using benchmarks to measure outcomes while supporting the learning of all students. With the enactment of the IDEA 2004 the emphasis of services within educational settings became to support children through the general curriculum (Polcyn & Bissell, 2005). The NCLB (2004) enforces the educational outcomes for all children while the IDEA 2004 promotes the services to support children with disabilities in learning (AOTA, 2009). Both NCLB and IDEA 2004 assert the need for evidence of effectiveness of services provided in schools. This same push for evidence-based practice is seen in occupational therapy (AOTA, 2009) and the joint goal of documenting individual progress toward specific goals allows for collaboration between teachers and occupational therapists (Asher, 2010).

Characteristics of Students

Inclusive classrooms are diverse in the characteristics and learning needs of the students. The needs of students receiving services under IDEA 2004 range from specific learning disability to emotional disturbances (U.S. Department of Education, National Center for Education Statistics, 2010), which highlights the variability in needs and required support services to facilitate participation and learning. The most prevalent population who receive services through IDEA 2004 is children with speech or hearing problems (U.S. Department of Education, National Center for Education Statistics, 2010). Children with specific learning

disabilities are characterized by difficulty understanding and processing language, which can affect both communication and mathematics (U.S. Department of Education, National Center for Education Statistics, 2010). Both diagnoses represent the common concerns with attention and learning problems for children who are receiving services through IDEA 2004. It is the characteristics of the student that dictate what related services are needed to ensure participation and learning in the general education classroom.

Sensory Processing

Some researchers and theoreticians have proposed that difficulties with processing sensory input could be the root of some behavioral and attention problems within the classroom (Polatajko, 2010). Parham (1998) suggested that an immature sensory processing system may impede classroom function because sensory processing disorders may interfere with the student's ability to regulate responses to sensations. Researchers estimate that some 5 to 13% of children within the general education classrooms demonstrate difficulties processing sensory information (Ahn, Miller, Milberger, & McIntosh, 2004) and that these difficulties can be manifest as behavioral concerns, attention difficulties, and decreased social skills. In addition, Gal et al. (2010) discussed the high morbidity of sensory or motor difficulties with other more challenging difficulties such as emotional regulation or attention. The prevalence of sensory processing difficulties and the resulting behavioral challenges, combined with the fact that teachers do not have training or expertise in providing interventions to address these concerns, creates a need for occupational therapists to partner with teachers to address sensory processing difficulties in their students and promote school success (AOTA, 2009; Bazyk & Case-Smith, 2010; Polcyn & Bissell, 2005).

Sensory processing theory describes the manner in which sensation can be used to

support attention and behavior (Ayres & Robbins, 1979) leading to increased productivity in the classroom (Polcyn & Bissell, 2005). Advocates of sensory integration intervention claim that proprioceptive input can inhibit the over-responding to other sensations that often leads to poor attention and behavior (Honaker & Rossi, 2005) allowing the child to better attend to task (AOTA, 2009) and demonstrate increased behavioral organization (Honaker & Rossi, 2005). In addition, some have proposed that vestibular input can help children to focus attention (Ayres & Robbins, 1979). Other research has proposed that interventions and environmental modifications designed to address sensory modulation difficulties in children with Attention Deficit Hyperactivity Disorder (ADHD) could be beneficial for entire classrooms (Mulligan, 2001). Dynamic seating options are one such environmental modification that can be implemented to provide proprioceptive and vestibular input to students while in the classroom.

The goal of occupational therapists who focus on sensory processing in their practice is to improve the client's ability to interact with the environment and therefore learn (AOTA, 2009). Participation in the normal classroom activities is an appropriate outcome for sensory processing interventions because the goal is to increase involvement in life (Strzelecki, 2008). Other researchers have discussed that participation involves active engagement in the learning process (Black-Hawkins, 2010).

Lack of Movement

Shifts in the schedule and teachers' expectations of classrooms have been noted over the past thirty years. Many of these changes are influenced by pressure to increase instructional time (Center on Education Policy, 2008; Center for Public Education, 2008) in an effort to meet the standards of NCLB (2004). Students now sit for some six hours during the school day, which heightens the importance of correctly fitting desks and chairs and the need for dynamic seating

(Cotton et al., 2002; Weimann, 1991; Wingrat & Exner, 2005). An average of half an hour recess per day has been cut out of the school day in the majority of elementary schools following the implementation of NCLB (Center for Public Education, 2008). Another analysis found that the time at recess decreased by one-fifth in elementary schools between 2001 and 2007, whereas physical education decreased by almost one-tenth (Center on Education Policy, 2008). The high-stakes testing associated with current education legislation has resulted in more instructional time at school on the specific subjects tested, which takes away time previously devoted to activities like recess and physical education (Center on Education Policy, 2008).

The decrease in opportunities for students to move at school is important to consider because of the effect movement has on the learning process. From the perspective of sensory processing theorists who believe proprioceptive and vestibular input is as beneficial to learning as visual and auditory input (Polcyn & Bissell, 2005) children are not provided sufficient opportunities for movement at school. Previous research has found that increased attention and work completion is associated with the use of controlled movement or dynamic seating options (Pfeiffer, Henry, Miller, & Witherell, 2008). Other researchers speculate that a decrease in movement opportunities at school will result in lower academic gains (Center for Public Education, 2008).

School-based Occupational Therapy

Teachers remain the primary professional involved with children in general education classrooms, but other related services supplement the traditional instruction. Related services, such as occupational therapy, can help support teachers in meeting the added demands found in inclusive classrooms. Related services are defined as those support services that "may be required to assist a child with a disability to benefit from special education" (IDEA, 2004,

§602.26). Related services personnel practice according to their respective professional domains of practice, but the emphasis remains on the educational outcomes of the students and is therefore governed by educational legislation and regulations. Several other related services that are supported through IDEA 2004 include physical therapy, speech-language pathology, counseling, and social work. Occupational therapy has been included as a related service throughout the educational reauthorizations of the past quarter century because of the close similarities in legislative goals and the scope of practice (Bazyk & Case-Smith, 2010).

School-based occupational therapists are qualified to partner with teachers in better meeting the diverse needs of today's students by providing assistive devices and accommodations to the traditional classroom environment. Occupational therapists have a professional focus on identifying barriers to performance and participation in meaningful activities (AOTA, 2002; Asher, 2010). Barriers often influence the success of inclusion in the classroom, which again highlights the role of occupational therapists in today's education system.

Previous emphasis in pediatric occupational therapy has been on modifying the individual's behavior with less emphasis placed on changing the environment, but focus is now shifting to ergonomic and sensory modifications to promote academic success (Asher, 2010). Ergonomic and sensory modifications tend to include environmental modifications, which is something that occupational therapists can facilitate in the school setting (Asher, 2010; Griswold, 1994; Swinth, 2009). The impact of these environmental modifications needs to be studied further to better understand the implications for inclusive classrooms.

Factors of interest to this study that influence performance at school, such as sensory processing and motor development, are within the domain and process of occupational therapy

(AOTA, 2002). Training in sensorimotor strategies to facilitate sensory processing allows occupational therapists to support teachers in making environmental modifications (Mulligan, 2001). Occupational therapy practitioners can help teachers and administrators consider the sensory properties of classroom furniture in order to make informed decisions about classroom modifications (Knight & Noyles, 1999; Polcyn, 2005). The role of occupational therapists in the school setting can be either direct intervention with children or it can be consultation to the teachers (Bazyk & Case-Smith, 2010; Swinth, 2009). It is through consultation with the teacher that the occupational therapist's professional expertise in environmental modifications and intervention strategies are shared (Swinth, 2009). A dynamic services approach like that of occupational therapists also pairs well with current educational demands in which a child's needs may vary by setting or expectation (Polcyn & Bissell, 2005).

Several other roles specific to school-based occupational therapists support the needs of all children in the education setting. Occupational therapists can act as advocates for modifications in schools by addressing the administration directly when necessary (Asher, 2010; Bazyk & Case-Smith, 2010). This contact with school administration can influence inclusion because availability of financial resources can often dictate what accommodations are made within the classroom (Gal et al., 2010). The long-term benefits of modifications to classroom furniture can also be addressed by the occupational therapists when discussing cost factors with school administrators (Polcyn & Bissell, 2005). The information gained from this study will help occupational therapists and teachers when considering alternative classroom furniture options for intervention with children in the school setting because it will assess several different options of varying cost. These alternative furniture options can supplement the changing demands placed on elementary school classrooms.

Furniture Options

A variety of nontraditional classroom furniture options are available that can help to meet the movement needs of students while they are engaged in instructional activities. Options for ball chairs, standing desks, and treadmill desks now exist for schools, each of which advertises benefits for users on multiple levels. Unfortunately, marketing does not always portray the reality of the effectiveness of these alternatives. Schools are understandably hesitant to invest in materials or tools until their value and cost-effectiveness is clearly evident, especially with the increasing fiscal demands placed on school systems. Both financial and societal standards influence what modifications are acceptable and therefore implemented (Eriksson & Granlund, 2004).

Dynamic classroom furniture allows freedom of movement and increased range of motion while students are learning and working. Previous work has assessed the effects of dynamic seating options on attention and handwriting in preschool and elementary school students (Schilling & Schwartz, 2004; Schilling, Washington, Billingsley, & Deitz, 2003). However, other dynamic furniture options such as Zuma cantilever chairs® (Virco Manufacturing) and standing desks with Original FootFidget® (Classroom Seating Options Standing Desk Conversion Kit) in the elementary school classroom need to be explored to examine the potential effect of these environmental modifications on student participation. The purpose of this study, therefore, will be to better understand the impact of dynamic classroom furniture, specifically Zuma cantilever chairs®, Disc‘O’Sits® (inflated seat cushions), and standing desks with Original FootFidget®, on attention to task, quality of work, and work completion for elementary school students with and without sensory processing or attention difficulties.

Method

Research Design

This study was part of a larger study designed to assess the effect of dynamic classroom furniture on attention as well as the influence of personal preferences in choice of furniture options. The larger study consisted of seven weeks followed by semi-structured interviews with the teachers. Data collection was conducted during baseline and all six weeks of intervention. For the first four weeks of intervention, each randomly assigned group was allowed one week to try each type of dynamic classroom furniture. The last two weeks of the intervention allowed each group of students two days to choose their preferred furniture option. The interview with the participating teacher was to gain insight into his/her perspective about using dynamic furniture in the classroom.

For the present study, data from the baseline and first two weeks of intervention were examined to assess the students' perceptions of responses to the different dynamic furniture options. A descriptive method was used to gather information about the interaction of dynamic classroom furniture with classroom behaviors, such as attention to task, quality of work, and work completion. The target outcomes measured, attention to task, quality of work, and work completion, also made the natural classroom environment a good setting for this study.

Participants

The elementary school population was chosen for this study due to the researcher's access to a convenience sample in a local school district. The sample was a second grade classroom in a private school in western Washington. All students in the classroom were included in this study to assess implications of different dynamic furniture options on the elementary school population. The exclusion criterion was any physical condition such as a

neuromuscular disorder or significant physical concerns that would inhibit the ability to sit unaided on dynamic chairs.

Environmental Adaptations

The environmental adaptations that were the intervention in this study included the use of three types of dynamic furniture options. The Zuma chair looks like a normal classroom chair, but allows the student to slightly rock back and forward as well as a "rocker brake" that limits how far the child can lean back. Zuma chairs are also designed to provide lumbar and mid-back support to students as they were specifically designed to match the ergonomic needs of younger students. The 15.5" seat height was ordered for this study to best match the size of the students. The Disc'O'Sit is an inflated cushion of 12" diameter and 1 ½" height that is placed on the normal classroom chair seat that the child sits on. It allows the child more freedom to wiggle in his/her seat while using the backrest of the chair for support. The standing desk will be paired with a stool and will allow the child to stand while working, allowing more movement than those at a normal classroom desk. The stools that accompany the standing desks were purchased from a local supermarket. After researching several options from educational vendors, the research team selected regular, wooden household bar stools. The stool leg lengths were then shortened to stool heights of 23", 24", 25", 27", and 29" to match the heights of the students. No other modifications were made to the classroom environment or routine beyond those described in the rubric and the dynamic classroom furniture.

Instrumentation

A standardized evaluation was used to screen the sensory processing of students and a daily self-report rubric provided data on attention behaviors and dynamic classroom furniture. The Sensory Processing Measure (SPM): Home Form (Parham & Ecker, 2007) was used in this

study to gain parents' view of the students' processing of sensory input. The SPM (Parham & Ecker, 2007) functioned as an initial assessment by providing information about the students' sensory processing skills, highlighting individual differences and preferences.

The SPM (Miller-Kuhaneck, Henry, & Glennon, 2007) was standardized on typically developing children in Grades K through 6. Results from a pilot study involving typically developing children yielded high internal consistency with Cronbach's alpha scores ranging from .97 to .99 for sensory processing environment items and .93 to .99 for items related to social participation (Miller-Kuhaneck et al., 2007). This level of internal consistency was strong enough to support clinical assessment of sensory processing (Henry, Ecker, Glennon, & Herzberg, 2009). The SPM was also found to correctly discriminate children with sensory processing challenges 82.4% of the time (Miller-Kuhaneck et al., 2007) indicating it was an effective tool for identifying children with sensory processing difficulties (Henry et al., 2009). For this study, the SPM (Parham & Ecker, 2007) provided potentially useful information about possible associations between sensory needs and preferences in classroom furniture.

The SPM (Parham & Ecker, 2007) is divided into eight scales to provide information on social participation, planning and ideas, and five sensory systems. The Social Participation (SOC) Scale on the Home Form (Parham & Ecker, 2007) measures the child's participation in social activities, including communication skills. The Vision (VIS) Scale represents a range of visual processing vulnerabilities, including ocular-motor function. The Hearing (HEA) Scale reflects difficulty to processing auditory stimuli, including perceptual difficulties. The Touch (TOU) Scale includes items referring to tactile defensiveness as well as tactile-seeking behaviors. The Body Awareness (BOD) Scale describes the proprioceptive system, or the ability to sense the position of limbs and body parts in space. This scale measures both excess sensory-

seeking behavior and disordered perception of input (Parham & Ecker, 2007). The Balance and Motion (BAL) Scale refers to the vestibular system, or the child's ability to maintain an upright posture and good balance. The Planning and Ideas (PLA) refers to the child's ability to conceptualize, plan, and organize movements, which depends on integration of the multiple systems. The Total Sensory Systems (TOT) Scale is a composite score of the five sensory systems (VIS, HEA, TOU, BOD, BAL), plus items that reflect taste and smell.

Throughout the intervention phase, students were asked to complete self-evaluations of their work performance. The use of a rubric (see Appendix A) specifically designed for this purpose was incorporated into the daily classroom routine to provide structured reporting of the dynamic seating experience. Rubrics have been shown to effectively document self-assessment of behavior and academic performance for school-age children (Lee & Lee, 2009). The rubric used in this study was designed in collaboration with the participating classroom teachers to evaluate student performance with and without the dynamic classroom furniture. Aligning the rubric with the teachers' existing routine has been advocated for promoting collaboration between researchers and teachers (Asher, 2010). Three scales were used on the rubric: Work Completion, Work Neatness, and Attention. Responses for Work Completion were focused on task completion and ranged from 1 (*I didn't finish anything*) to 5 (*I finished early and moved to the next activity*). Responses for Work Neatness referred to neatness of work and ranged from 1 (*It looked very bad and sloppy)* to 5 (*It was my very best work and it was very neat*). Responses for Attention were specific to attention behaviors and ranged from 1 (*I talked with my neighbor and I played with items in or on my desk*) to 5 (*I was focused the whole time. I did not talk or play and I followed directions*). Students were also provided space to report if they used the dynamic furniture while away from their desks. Time of day and activity were recorded to assess

the influence of schedule and the different subjects on students' perception of attention and work completion.

Procedure

The protocol for this study was submitted to and approved by the university human subjects review board and then permission was sought from the school district. After approval was obtained from the school district, a letter addressing the focus of this study was sent to all teachers of grades 2-4. The classroom for this study was selected by the principal from the names of all teachers who expressed interest in participating in this study. The participating classroom was taught by two teachers who job-share. Each teacher was responsible for teaching the class on two days a week with the fifth day being taught by each teacher on a rotating basis. A letter was provided to these teachers for distribution to the students in their classroom. This letter described the study and also requested parental consent and student assent for participation. The teachers explained the study to the students, sent the consent forms home with the students, and followed up in person with the parents to obtain the signed forms.

Set-up. Once consent and assent were obtained for all students in the classroom through returned signed forms, the researcher met with the participating teachers to create the final rubric that matched the existing routines of the classroom. In this meeting it was also decided that the weekly transition between furniture options would take place just prior to school dismissal on Fridays to decrease disruption of classroom routines. It was also agreed upon that the researcher would assist the teachers in fitting the furniture to the students and rearranging the classroom as needed prior to each phase of the study to decrease the time required of the teachers. Classroom management strategies already included rearranging the furniture every other week and therefore the agreed upon procedures for this study were chosen to match the existing routines well. The

furniture was arranged so as to match existing pattern (see Figure 1), with the standing desks in the back row (see Figure 2).

For the study, the class was randomly divided into four groups of up to five students to allow each student the opportunity to experience each furniture option. Group assignment was based on order of returned consent forms. The groups were labeled 1-4 to denote order of rotation through the furniture options. Students were assigned a participant number of 1-19 based on order of returned signed consent forms to match individual responses on the rubrics and the parent report on the SPM (Glennon et al., 2007). The first five students were placed in Group 1 with the next five students placed in Group 2, until all of the students had been placed in a group. The order of furniture options was predetermined and groups were randomly assigned to a sequence.

Baseline. The daily rubric was introduced into the existing classroom routine during the one week preceding the intervention to obtain baseline information about students' perceptions of attention behaviors and work completion while using traditional classroom furniture. Introduction of the data sheet into existing routines allowed students to learn to use the rubric prior to data collection, decreasing any effects the assessment tool might have.

Intervention. Intervention consisted of an exploratory period and two phases. The groups were randomly assigned an order to try each furniture option for a week (see Table 1) and then the groups would rotate to the next furniture option. The order of furniture options was also recorded to provide information about any effects based on sequence. During the exploratory phase students used each type of dynamic furniture for one half day. The exploratory period aimed to decrease the effects of novelty. Phase 1: Each group of students was randomly assigned to a type of furniture for a week. Phase 2: The groups rotated to use another type of furniture for

the next week.

Data Collection

Due to the time constraints on teachers, the parents completed the home form of the SPM (Parham & Ecker, 2007), which was allowable by design of the measure (Miller-Kuhaneck et al., 2007). Parents were informed that the SPM (Parham & Ecker, 2007) takes from 15 to 20 minutes to complete. The rubric was completed three to six times per phase, with variability based on classroom schedule. Classroom schedule dictated completion of the rubric because it was designed to follow a period of seated activity. The researchers had anticipated observations in the classroom, but this was not chosen as a good match for the current classroom routine.

Data Analysis

The quantitative data obtained in this study from the SPM scales (Parham & Ecker, 2007) and rubrics were entered into SPSS Statistics 17.0 to calculate descriptive statistics about the students prior to intervention as well as information on work completion, work neatness, and attention. The data for each group was graphed separately across weeks to assess trends in responses to furniture options and to determine if any sequencing effect existed. Each of the three variables from the daily rubric was represented separately in these graphs to assess the different types of responses to each furniture option. The means of responses on the rubrics were computed for each student by phase to better assess trends in the data. Students who were identified to have difficulty processing sensory input through scales scores on the SPM (Parham & Ecker, 2007) were further compared with responses from the rubrics to assess if any other factors, such as ability to process different types of sensory input, influenced responses to furniture. The researcher analyzed any relationships between sensory processing and responses to dynamic furniture through visual inspection of graphs based on the student responses on the

daily rubric.

Results

The sample included 19 students in a classroom that had two cooperating teachers. Demographic information about the participants was obtained through the SPM (Parham & Ecker, 2007) and is presented in Table 2. The teachers in the participating classroom work well together even though they have varying levels of teaching experience. One of the teachers has been teaching for six years, three of those full-time and three of those in job share agreements. She is currently working on her pro-certification and the creation of the rubric used in this study was included in her portfolio. This teacher loves learning and is eager to try new ideas, room arrangements, and teaching strategies. She was aware of some students' need to fidget prior to learning of this study. The other teacher is finishing her first year of working as a certified teacher after returning to school. Prior to returning to school, she worked for 16 years in a variety of support roles in the field of education. Both teachers expressed an increased awareness for the movement needs of their students as well as an understanding for their responses to movement within the classroom because of this study. No modifications to classroom management occurred during this study.

SPM

In this class of 19 students, eight were identified as having *some problems* processing sensory input (see Table 3); including two students (Participants 1 and 12) identified as having *definite dysfunction* on the SPM (Parham & Ecker, 2007). The most common scale for students identified with *some problems* was VIS, with five students identified; followed by BOD and BAL, both with four students identified. The random group assignment resulted in one group (Group 3) in which four out of five students were identified by the SPM (Parham & Ecker, 2007)

as having *some problems* processing sensory input while two of the groups (Groups 1, 4) had two out of five students were identified as having *some problems* and one group (Group 2) had only one student identified as having *some problems*. Cultural or language differences may have influenced the rating of one child who was scored as *definite dysfunction* on the SPM (Parham & Ecker, 2007).

Rubric

Each mean of responses for the variables on the rubric were graphed by phase with each participant's response identified. One student was not present during baseline (Participant #18). Variance was observed between the different students' responses on each of the three variables based on type of furniture. The responses for some students were more drastic whereas some students responded the same way to each type of furniture. The variability in time of day reported on the rubrics was not great enough to assess differences in responses based on time of day. The responses based on subject matter were also not analyzed due to limited variability.

Work Completion

All of the groups appeared to report different amounts of work completion from week to week. Upon visual inspection, the participant in Group 1 (see Figure 3) who reported a decline in ability to finish work while using the standing desk also received a score of *some problems* on the SPM (Parham & Ecker, 2007) for vision and balance. It was interesting that in Group 2 (see Figure 4), which had traditional furniture twice (baseline and Phase 2); no student reported the same at both exposures to traditional furniture. Similarly, Group 3 (see Figure 5) had traditional furniture during baseline and Phase 1 with none of the students' responses the same between those two weeks. One participant in Group 3, who was noted to have *some problems* on the SPM (Parham & Ecker, 2007), reported a decline in ability to finish work while using the Disc'O'Sit

as compared to the two weeks of using traditional furniture. Group 4 (see Figure 6) was the only group to not have any student decrease in performance between the baseline and Phase 1. Group 4 was also the only group to not have any student decrease in performance between Phase 1 and Phase 4. Only one student reported below 4 (*I finished all of it*) when using the traditional furniture during baseline and was scored on the SPM (Parham & Ecker, 2007) as having difficulty processing sensory input related to balance. Another student reported below 4 (*I finished all of it*) during either of the phases, who was scored as having normal responses to sensory input on the SPM (Parham & Ecker, 2007).

Work Neatness

Visual inspection showed more variance in reported responses for work neatness than for work completion. The largest changes in performance for Group 1 (see Figure 7) were for children who were scored on the SPM (Parham & Ecker, 2007) as having normal responses to sensory input, with one child benefiting from the Zuma chair and another benefiting from the standing desk. In Group 1, participant 4's perceived neatness increased with the standing desk compared to both the traditional furniture and the Zuma chair. Group 2 experienced the traditional furniture, the standing desk, and then the traditional furniture again and no participant reported a decrease in self-assessment of quality of work over the duration of the study (see Figure 8). Group 3 (see Figure 9) appeared to have the lowest ratings with the traditional furniture and 3 of 5 participants reported improved work neatness with the Disc'O'Sit. Group 4 showed similar trends to Group 2 in that no participant reported a decrease in quality of work over the duration of the study (see Figure 10). This trend was interesting in that Group 4 experienced the traditional furniture, the Disc'O'Sit, and then the Zuma Chair. Group 4 included the student who showed the greatest change over time among any of the variables.

Attention

Based on visual inspection it appeared that the highest responses across the three variables were related to ability to focus on task. The only participant in Group 1 (see Figure 11) to show declines in ability to focus (Participant 4) was scored to have problems processing sensory input and the declines were noted with the standing desk. Group 2 (see Figure 12) appeared to have the most consistent responses in ability to focus on task across the traditional desk and the standing desk. Groups 3 and 4 (see Figures 13 and 14) both included two participants with greater and yet opposite responses to the types of furniture.

Initial Qualitative

Although the semi-structured interview was included in the larger study, some qualitative data still came in the present study. The participating teachers reported that prior to this study, one of the students in the participating classroom was observed to stand at her desk rather than sit in her seat for the majority of the time. Other teachers in the school were observed to stop by the classroom to ask questions about the furniture and to try out the different options. Every teacher that came to explore the new furniture options used in this study expressed how applicable they would be in their classrooms. When the furniture was first dropped off in the classroom, three of the students sat on the Zuma chairs and expressed that they did not like them because they were “too small.” This perception of the Zuma chairs was consistent throughout the study as the students were shorter when using this option, especially when compared with the standing desk. The participating teachers reported occasionally being distracted by students that aggressively worked the foot fidget while using the standing desk. Two of the students were observed to use their whole body to pump up and down on the foot fidget; the more extreme student was described as being a “rough and tumble girl who often has large motions” (J.

Broberg, personal communication, April 28, 2011). Several students were observed by the teachers to use the Disc'O'Sit on the floor during free reading time or different learning stations around the room. Both participating teachers reported an increased awareness for and tolerance toward the movement needs of their students.

Discussion

The study was conducted in the participants' general education classroom. This setting best matches the goal of No Child Left Behind (2004), the Individuals with Disabilities Education Improvement Act (IDEA, 2004) and the initiative for early intervening services or response to intervention (IDEA, 2004) of providing services whenever possible in the natural setting of the classroom. Though research in the classroom often limits the amount of control the researcher can impose on the study, it may increase the external validity of the findings. Although this study was conducted in a private school classroom, the number of previously unidentified students with sensory concerns may match those in most general education classrooms that do not have any students who are receiving related services based on the prevalence of students in general education classrooms who demonstrate difficulty with sensory input (Ahn, Miller, Milberger, & McIntosh, 2004).

Implications for students. The trends in classroom behavior observed in these data were different from previous research (Pfeiffer et al., 2008; Schilling et al., 2003; Schilling & Schwartz, 2004) in that no consistent interaction between type of furniture and task completion, work neatness, and focus was observed. Rather, it appears that personal characteristics influenced the effects of the different types of dynamic furniture. The behaviors the teachers reported about the students of this classroom were consistent with previous studies (Pfeiffer et al., 2008) in that a transition period of disruptive behavior occurs with environmental

modifications prior to the demonstration of adaptive behaviors such as bouncing their feet on the foot fidget or preferring one side of the Disc'O'Sit to the other. By the middle of the first week of intervention, the behaviors observed by the teachers were consistent with those prior to implementation of the study.

The trends in responses to furniture options showed no clear relationship based on ability to process sensory input. Children with scores indicating difficulty processing sensory input and children with scores indicating normal responses to sensory input demonstrated similar responses to furniture. Participant 18 was identified through the SPM (Parham & Ecker, 2007) to have *some problems* processing sensory input, particularly for touch and balance, which may be related to the increased perceived neatness with the Disc'O'Sit and Zuma chair compared to the traditional chair because these furniture options allowed the student some controlled movement while seated. Participant 4, scored with *some problems* for vision and balance, but neatness was reported to increase with the standing desk compared to both the traditional furniture and the Zuma chair. It was interesting to note that Participant 4 reported declines in ability to focus with the standing desk, indicating that the types of furniture did not interact with the variables of interest in a consistent pattern. The student in Group 3 (Participant 15) who showed a decline in ability to finish work while using the Disc'O'Sit after the two weeks of traditional furniture was noted to have *some problems* on the SPM (Parham & Ecker, 2007), but this was in relation to hearing. Polatajko proposed that difficulties with processing sensory input may be the basis for some behavioral and attention problems (2010), but this link between sensory difficulties and performance deficits is not well substantiated (Koenig, 2010). In the current study, a positive or negative change in classroom behaviors did not appear to be related to the student's ability to respond to sensory input provided through the available furniture options.

Implications for inclusive educational practices. The ratio of students with scores on the SPM that indicated some or definite dysfunction in processing sensory input was greater than a previous study. Ahn et al. (2004) found that almost 14% of kindergarten students met criteria for sensory processing disorders based on parent report and whereas this study 42% of the students in the class scored with some difficulty processing sensory input according to parent report. A conservative view of these statistics should be taken as both are based on parent report and Ahn et al. (2004) reported that a formal screening only identified 5% of those same children as having sensory processing disorder. It is interesting to note that both studies used different instruments to identify children with sensory processing difficulties: Ahn et al (2004) used the Short Sensory Profile (Dunn, 1999) and this study used the SPM (Parham & Ecker, 2004).

It was also interesting to note that the different types of furniture impacted different components of learning in a variety of ways. Even within the same type of furniture, students responded in different ways based on student self-report on the rubric data. Some students reported being better able to finish their work, but the quality of work decreased. This was clear with Participant 4 who reported decreased attention while standing, but increased work neatness. Likewise, the trends in responses to furniture were not consistent within the group, possibly indicating that individual responses to furniture are important to consider.

Adaptations and modifications to the learning environment are found to benefit all learners, not just those identified as needing supports to facilitate learning. This idea is consistent with a previous study (Mulligan, 2001) that alluded to the benefit of interventions such as sensory modulation strategies and environmental modification to all students because the furniture was found to benefit all students in the classroom in some way, although the results and areas of improvement varied. The classroom used in this study demonstrates the application of

environmental modifications in general education classrooms and the benefits that these modifications pose to children who do not need extra supports for learning. Individual differences were noted in response to each of the furniture options, or even among the same option at different times, which illustrates the high level of variability within the typical population.

This classroom was also consistent with most general education classes in that the traditional furniture was not fitted to the children. The traditional chairs had a seat height of 18", which is the appropriate height for the average adult size. Also, none of the desk heights had been adjusted to meet the ergonomic needs of the individual children. The furniture used in this study was matched to each individual child as close as possible, but it was interesting to note the students' comments about the fitted furniture. Several students commented that the Zuma chairs were too small when they first tried them, but they soon adapted and no decline in performance was noted. Incorrect fit for the students' size may have also occurred with the Disc'O'Sits because these were placed on the traditional chairs, which were already too tall for the students. The 15.5" seat height of the Zuma chairs was a contrast to the traditional chairs and it was reasonable for the students to report feeling short when using the Zuma chairs. The Zuma chair height was determined to match the majority of the students' heights, but it may have been too short for some of the students. By adjusting the furniture to match the individual heights of the students, the teachers gained an increased awareness of the importance of correctly fitting furniture. Previous research reported the improved attention and academic performance that is associated with correctly fitting furniture (Knight & Noyles, 1999; Wingrat & Exner, 2005), which should be considered in classroom management strategies that support inclusive practice.

Implications for related services. Members of the multidisciplinary team that includes

the related services that support students' learning offers their professional expertise to supplement that of the teacher. Environmental modification is an area that related services provide may implement change to better the learning situation for students. Service delivery may occur at three different levels: individualized intervention, consultation for classroom strategies, and conversations with school administration. The traditional model for related services in schools often is individualized interventions that are specific to the learning needs of a child. A shift toward interventions implemented as part of the daily classroom routine is now occurring, which is something that the findings of this study support, rather than just an individualized approach. Environmental modifications such as dynamic furniture options were found to benefit the whole class, with no distinction between normal responses to sensory input and difficulty processing sensory input, and this matches previous work that looked at the use of specific interventions to benefit all learners in the class (Mulligan, 2001).

Personal preferences of the teachers, such as allowance of movement within the classroom and flexible classroom management strategies, may also have impacted the decision to participate and response of students in this study because not all teachers would accept movement in the classroom. Dynamic furniture may not match a highly structured classroom as well as it would match a classroom with flexibility. Several other teachers at the school expressed interest in using the dynamic furniture, which may illustrate the receptiveness of teachers to the interventions that related services personnel have to offer. The time commitment in follow-up to the environmental modifications is worth noting because it can take time to find the best match between furniture and student. Likewise, every environmental modification requires time to implement, whether adjusting the height of desks or rearranging furniture. Another distinguishing characteristic of this classroom was that the teachers had a previous

routine of changing the classroom furniture arrangement about every other week, which may have lessened the negative impact that might be associated with the procedure in this study if it had been implemented in a different classroom.

The two preferred furniture options, Disc'O'Sit and standing desk with foot fidget, were relatively inexpensive. The cost of environmental modifications or other intervention strategies is of interest to school administration (Polcyn & Bissell, 2005) and this study highlighted the cost-effectiveness of these environmental modifications because the dynamic furniture options were found to have a positive effect. Related service personnel, especially school-based occupational therapy, are qualified to address the administration directly concerning funding options for environmental modifications such as those presented in this study (Swinth, 2009).

Limitations

Several limitations exist within this study. The baseline phase resulted in only one completed rubric per student due to the school schedule. In addition, the exploratory phase was shortened to three days. The exploratory phase was intended to provide enough time to decrease the novelty effect, but it might have not been long enough to account for the transition phase in behavior. The lack of data from the exploratory phase also limits our understanding of the adaptive process related to the furniture. Similarly, the short baseline may have limited the students' familiarity with the rubric and may have therefore affected their reporting.

The height and fit of the traditional furniture may have added to the adjustment process because the dynamic furniture was fitted to the individual children. Conversely, it may have decreased the novelty of the sensory properties of the new furniture because the students were already adapting to the size and fit of both the traditional furniture and the dynamic furniture options. Another limitation was the lack of movement reported with the Zuma chairs. These

chairs were marketed as providing a slight rock while the student is seated, but this was not consistent with student report in this study.

Some inconsistency existed in frequency of collecting data with the rubrics. The timing of rubric completion was left to the discretion of the participating teachers, which meant that some days resulted in two rubrics whereas other days resulted in none. Subsequent research could be strengthened by a rubric collection schedule to ensure that consistent timings of data collection occurred. Similarly, the SPM: Home Form (Parham & Ecker, 2007) may have not truly reflected the students' responses to sensory input in the classroom and an instrument specific to that environment may have provided better information. It is also interesting to note that 18% of the rubric entries refer to a Bible lesson, which is specific to Christian private schools, and may not necessarily generalize to public school classrooms. Focused observations on the classroom may have strengthened this study by supplementing the information obtained through the daily self-report rubrics.

Future Research

The final stages of the larger study will further look at student preferences for different types of furniture. It will also include an interview with the teachers to explore the impact of the dynamic furniture on classroom management. Future research could expand these findings by analyzing the effect of furniture over time by student. This would yield information about the rates that students can develop adaptive behaviors and if any variance in adaptive strategies is observed by type of dynamic furniture. Longer baseline and exploratory periods would strengthen the understanding of existing behaviors within the classroom as well as the adaptive process in regard to the new types of furniture. The results of this study may be strengthened through replication in a classroom that has several students previously identified as having

difficulty processing sensory input. Replication of this study in a larger classroom would also better match trends in classroom size and could provide more information about the effects of dynamic classroom furniture on classroom management. The exploratory nature of this study also yielded direction for further research.

Further research could also look at the ways that students use the furniture options. Students were allowed to report if they preferred the smooth or the bumpy side of the Disc‘O’Sit, but this was not a direct focus in this study. The one student who preferred the bumpy side of the Disc‘O’Sit was scored to have some problems with sensory input related to body awareness. Two students reported preferring the smooth side of the Disc‘O’Sit, one of which had scored as having some problems processing sensory input and one of which scored as having normal processing of sensory input. Two students were also observed by the teachers to put the Disc‘O’Sit against the back of their chair and lean on it rather than sit on it. One of these students was reported to have difficulty processing auditory input and the other was scored as having normal responses to sensory input. Leaning against the Disc‘O’Sit or using it on the floor was never offered as an option, but it was interesting to note how the students chose to use the dynamic furniture options. The individual preferences for using the Disc‘O’Sit illustrate an area for further research. Similarly, the preferences of the students toward using the foot fidget highlight this furniture option, apart from the standing desk, as an area for future research. Students were also observed to sit on the stools at the standing desks rather than primarily standing and leaning against the stools to offset fatigue.

Implications for Occupational Therapy

The IDEA 2004 and NCLB affects nearly all public school classrooms in the United States. Under these laws, school districts are faced with the challenge of supporting the needs of

all types of students in the least restrictive environment while also meeting achievement standards. Previous work hypothesized that it was easier to modify the environment and the task than the child (Egilson & Traustadottir, 2009) and teachers and administrators are interested in options that support learning across the broad needs in their classrooms. It is important for school-based occupational therapists to increase awareness of the impact physical environments can have on learning.

With the increasing fiscal demands placed on school districts, cost-effective options should be considered to support the learning process of their students. School-based occupational therapists can collaborate with teachers to provide environmental modifications to support the learning process of their students. Multiple furniture options exist for classrooms and it is important to assess the effectiveness of these different options across a broad spectrum of students. Occupational therapists can help educators understand the implications of the sensory properties of classroom furniture options and how these can affect student engagement in educational activities. This study provided exploratory evidence supporting the use of a variety of furniture options to increase attention and work completion in an elementary school classroom.

Summary

The purpose of this study was to better understand the effects of several types of dynamic classroom furniture on classroom behaviors for elementary school students with and without sensory processing or attention difficulties. A descriptive methodology was used through parent report on the SPM (Parham & Ecker, 2007) and student report through daily rubrics to gather information about the interaction of dynamic classroom furniture with classroom behaviors, such as attention to task, quality of work, and work completion. The data from this study indicates that

no one type of furniture provides the same effect for all elementary students, but rather that personal characteristics may dictate the best match for focus, work completion, and neatness.

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Appendix 1. Daily self-report rubric

Student #: _____ Activity: _____
Date: _____ Time of Day: _____
Furniture: _____
How did I do getting my work done?

I didn't finish anything.	I finished some of it.	I finished most of it.	I finished all of it.	I finished early and moved to the next activity.

How did my work look?

It looked very bad and sloppy.	It looked a little sloppy.	It looked okay, but I could have done better.	It looked good.	It was my very best work and it was very neat.

Did I focus on my teacher and/or work?

I talked with my neighbor and I played with items in or on my desk.	I played with something in or on my desk.	I was talking when I wasn't supposed to.	I didn't talk to my neighbor or play with anything in my desk, but I was a little distracted.	I was focused the whole time. I did not talk or play and I followed directions on my work.

Did I use my furniture away from my desk? Yes No

Table 1

Furniture Assignment by Group

	Group 1	Group 2	Group 3	Group 4
Week 1	Zuma Chair	Standing Desk	Traditional Desk	Disc‘O’Sit
Week 2	Standing Desk	Traditional Desk	Disc‘O’Sit	Zuma Chair

Table 2

Demographic Information on Participants

Characteristic	*n*	%
Sex		
Male	7	36.8
Female	12	63.2
Race		
Asian	3	15.8
Black/African American	1	5.3
Native Hawaiian/Pacific Islander	1	5.3
White	7	36.8
Other	2	10.5
Missing	5	26.3
Age		
< 8	4	21
8 – 8.6	10	52.6
8.7 – 9	4	21
> 9	1	5.3

Table 3

SPM Results

	SPM Scales							
Participant	SOC	VIS	HEA	TOU	BOD	BAL	PLA	TOT
1	1	2	2	2	2	3	2	2
2	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1
4	1	2	1	1	1	2	1	1
5	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1
11	1	1	1	1	2	1	1	1
12	2	2	3	2	2	2	1	3
13	1	1	1	1	1	1	1	1
14	1	1	1	1	2	1	1	1
15	1	1	2	1	1	1	1	1
16	1	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1	1
18	1	2	1	2	1	2	1	2
19	1	2	1	1	1	1	1	1

Note. 1 = Normal; 2 = Some problems; 3 = Definite dysfunction.

Figure 1. Prior Classroom Arrangement

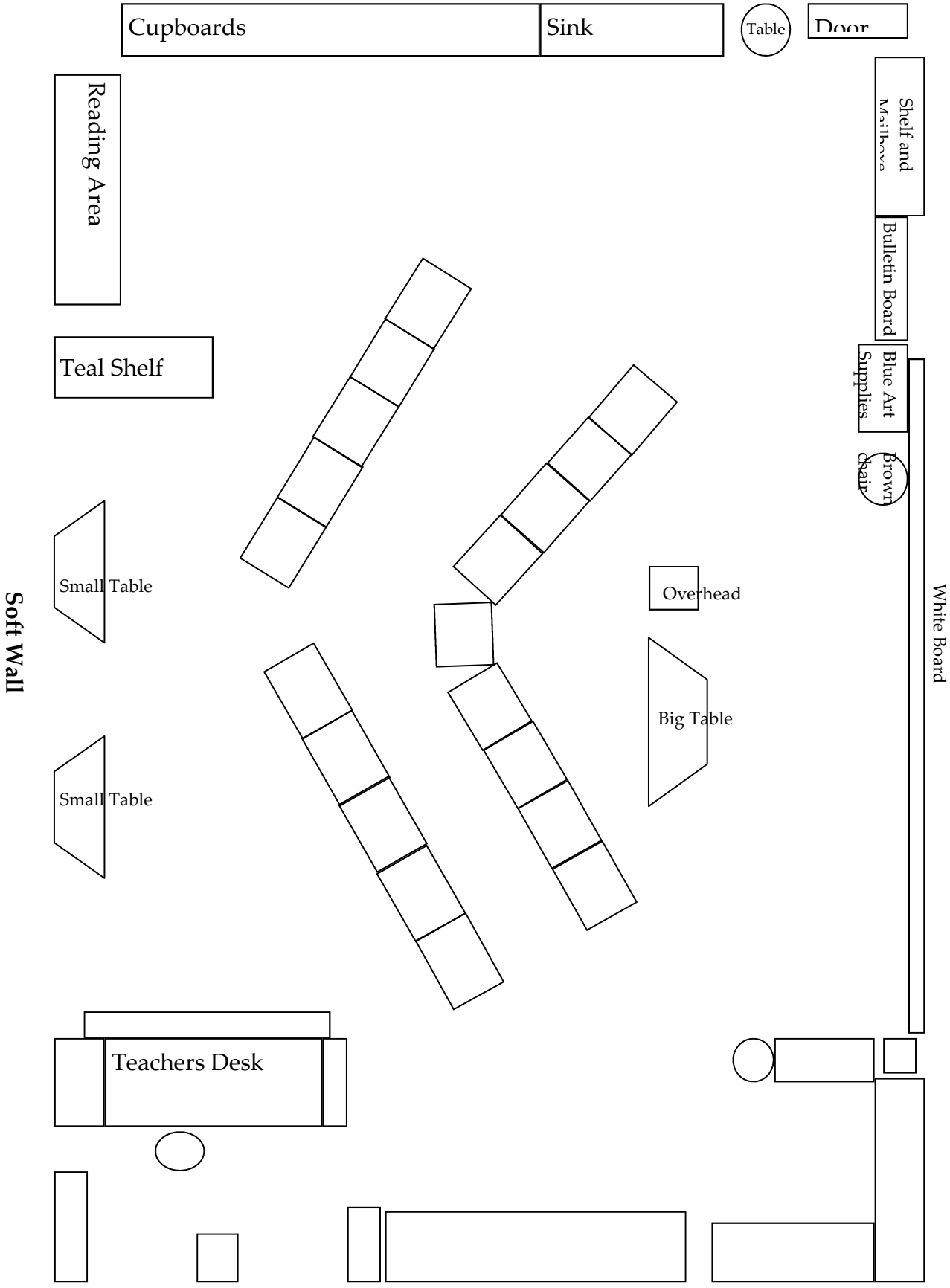

Figure 2. Classroom Arrangement with Intervention

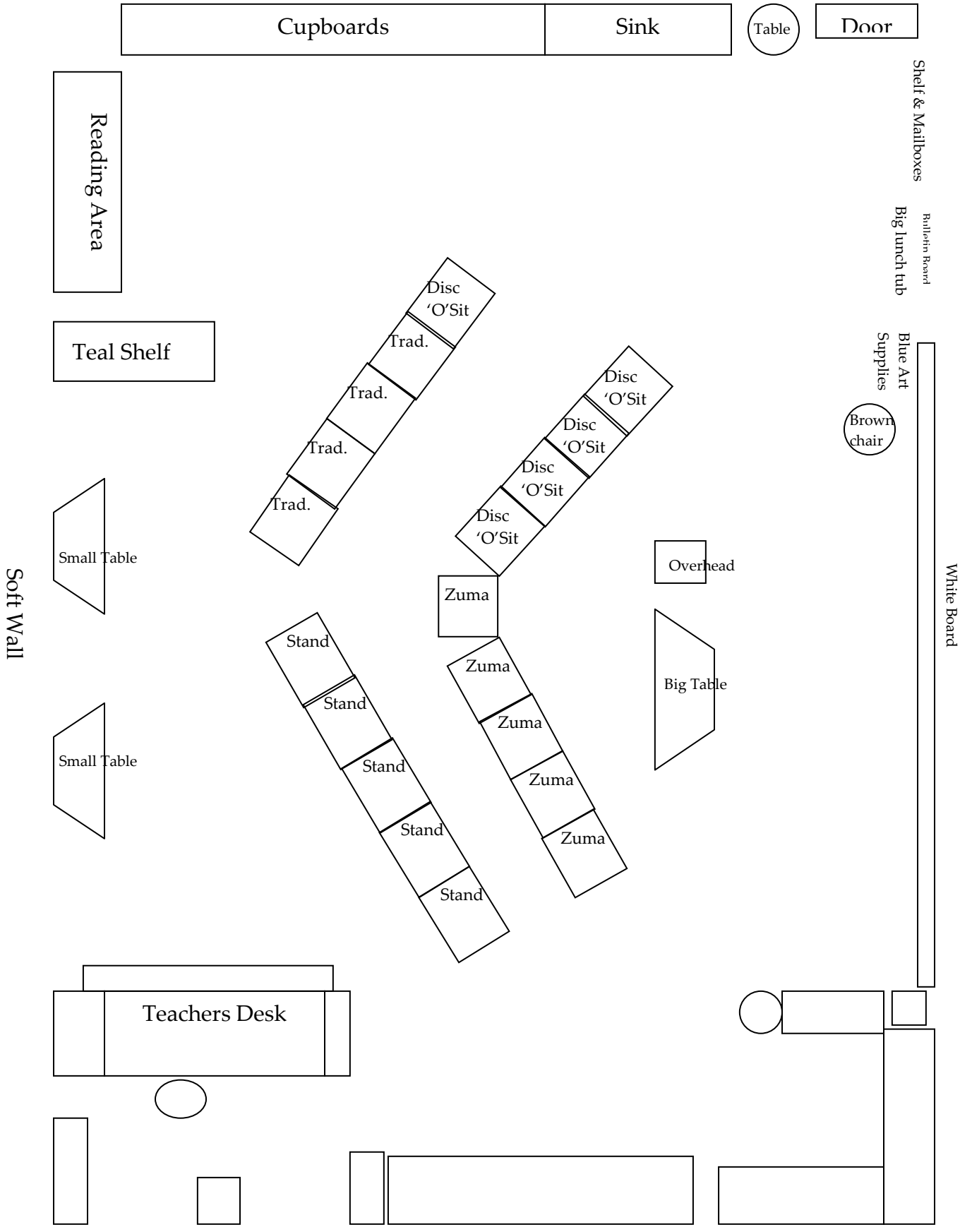

Figure 3. Rankings from Rubric for Group 1 on Work Completion Across Types of Furniture

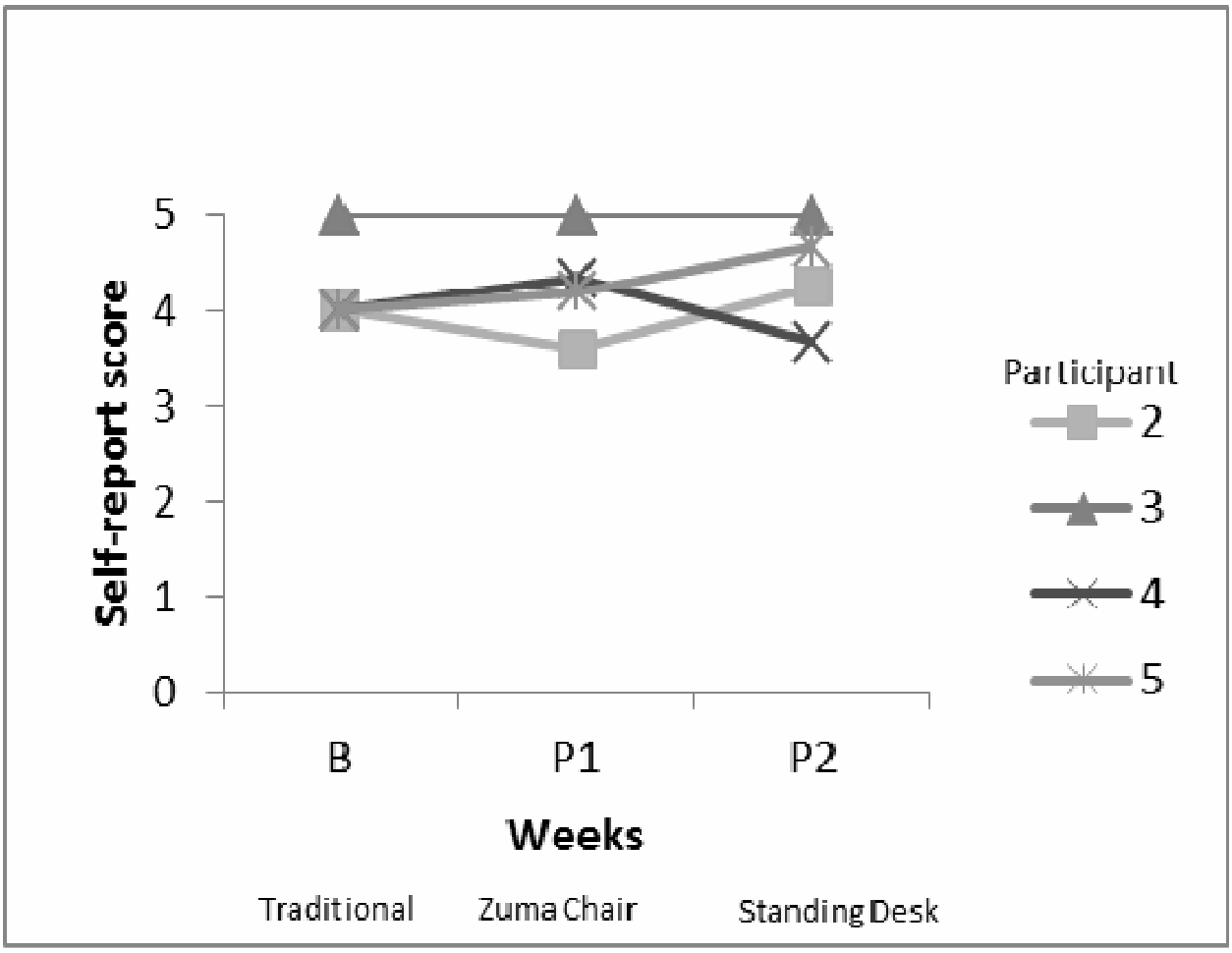

Figure 4. Rankings from Rubric for Group 2 on Work Completion Across Types of Furniture

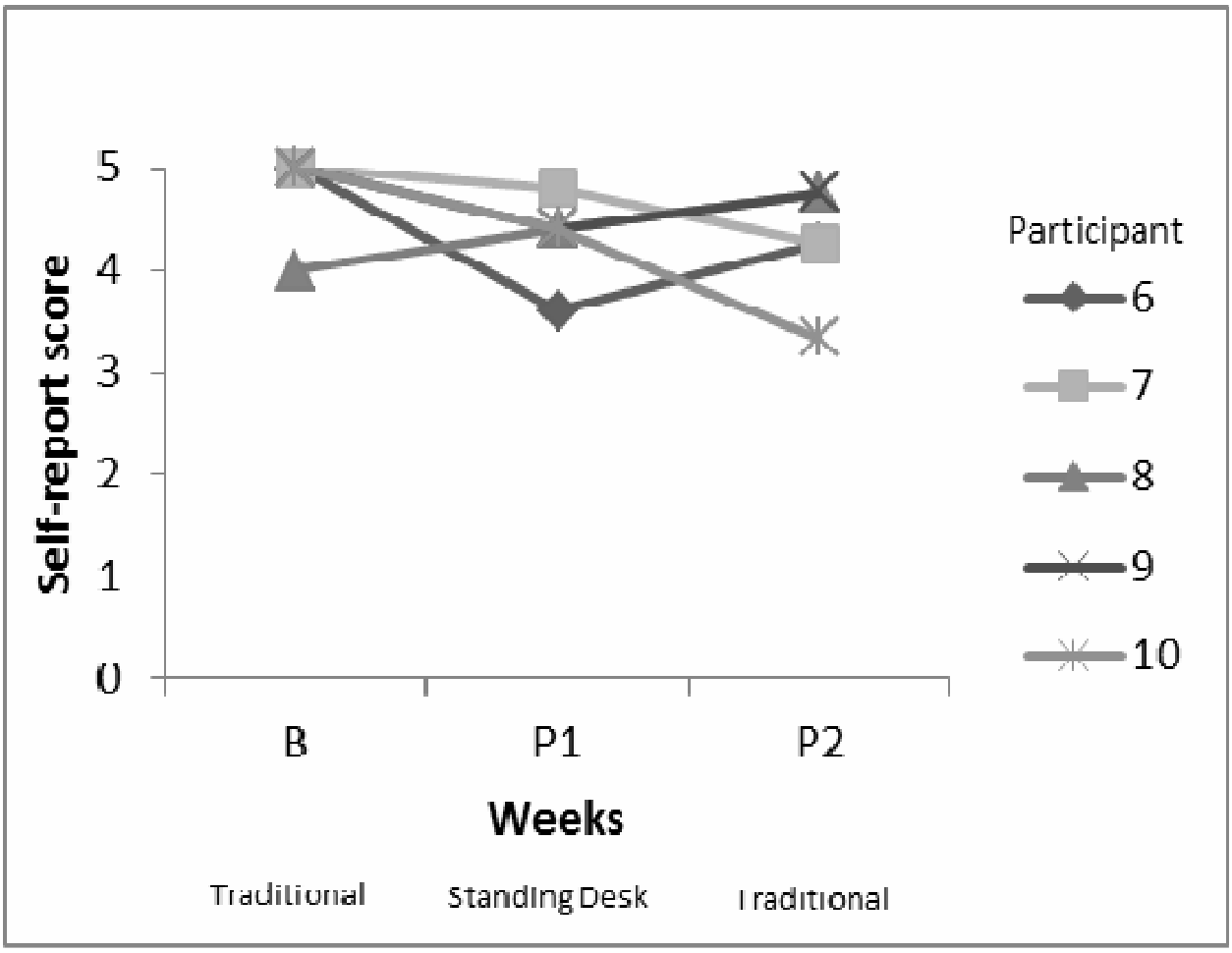

Figure 5. Rankings from Rubric for Group 3 on Work Completion Across Types of Furniture

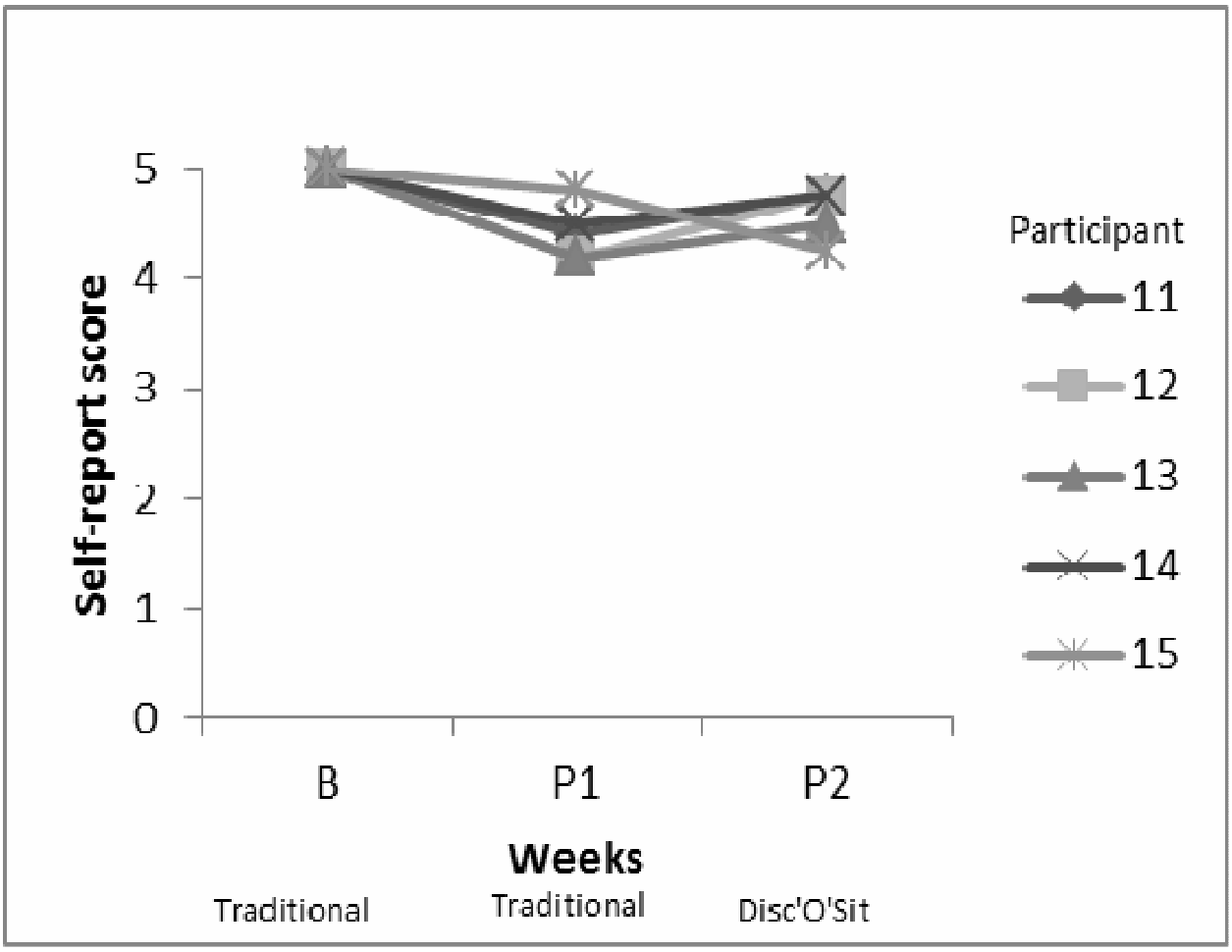

Figure 6. Rankings from Rubric for Group 4 on Work Completion Across Types of Furniture

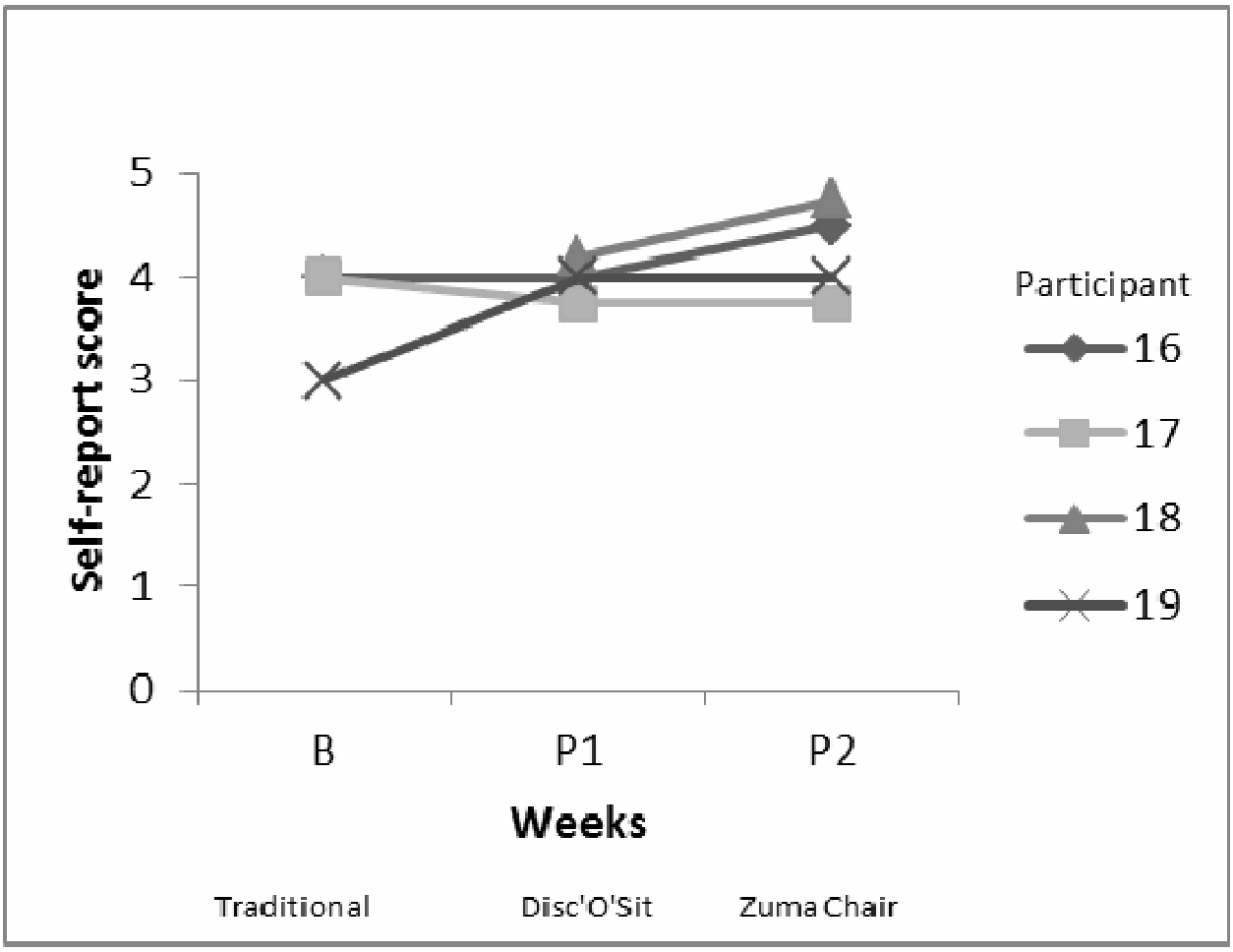

Figure 7. Rankings from Rubric for Group 1 on Work Neatness Across Types of Furniture

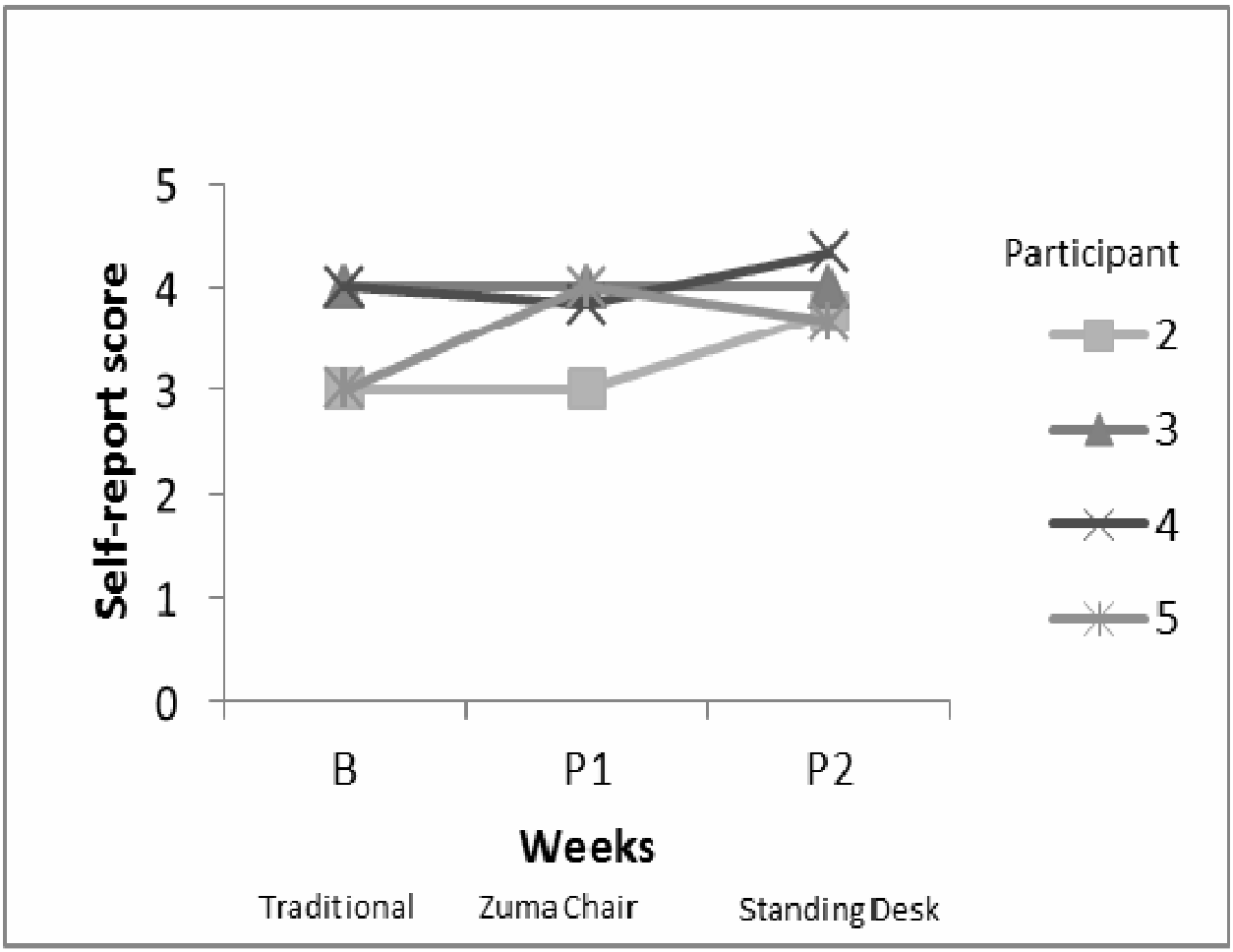

Figure 8. Rankings from Rubric for Group 2 on Work Neatness Across Types of Furniture

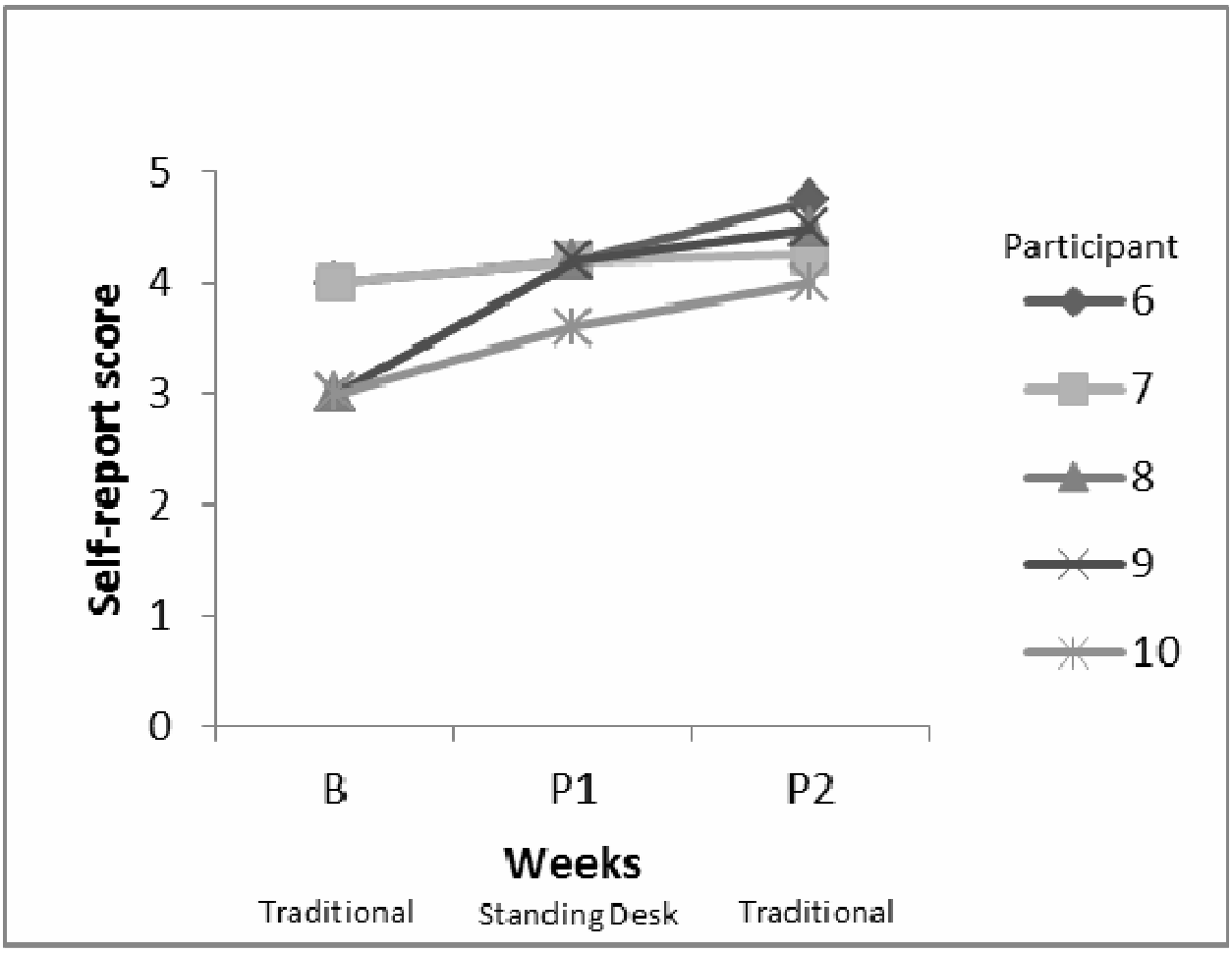

Figure 9. Rankings from Rubric for Group 3 on Work Neatness Across Types of Furniture

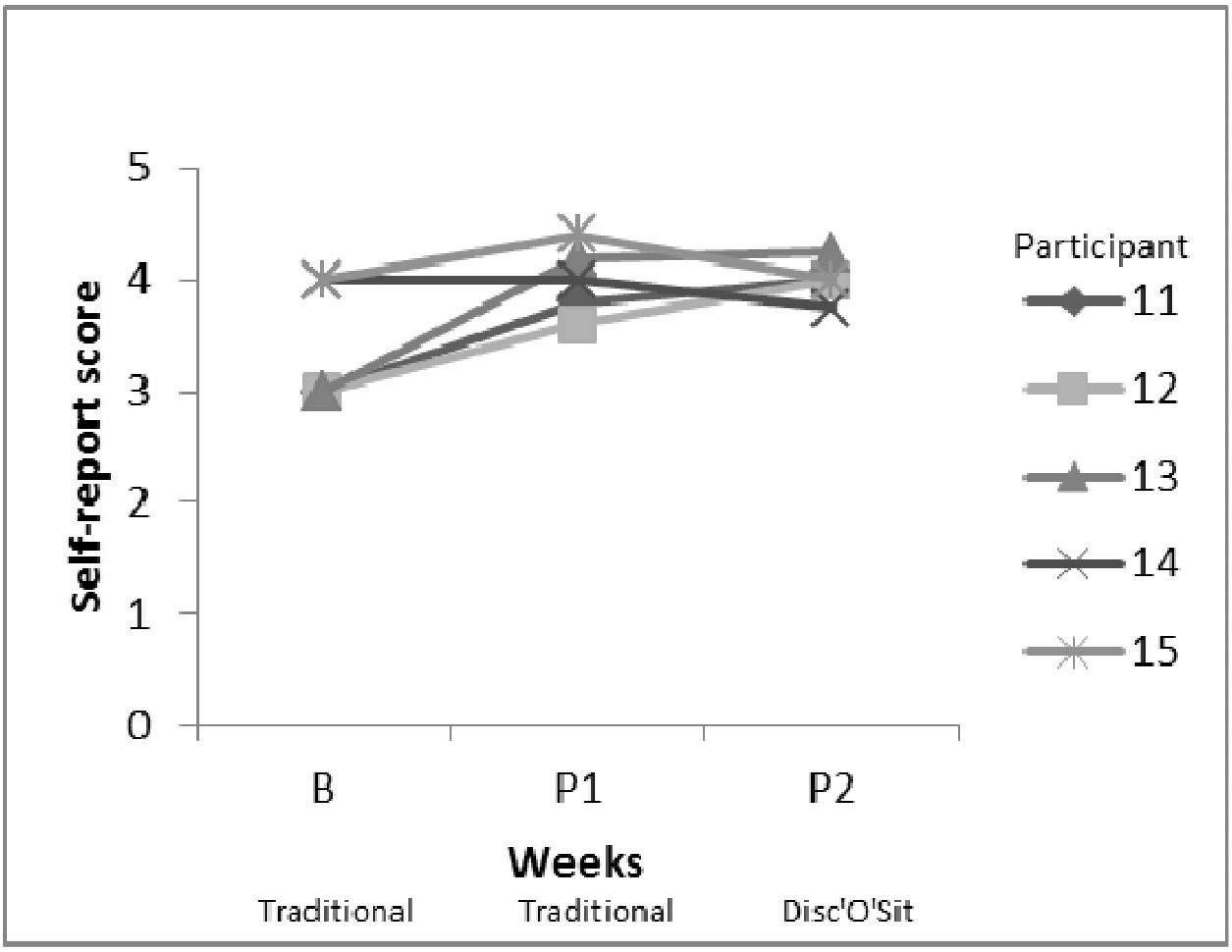

Figure 10. Rankings from Rubric for Group 4 on Work Neatness Across Types of Furniture

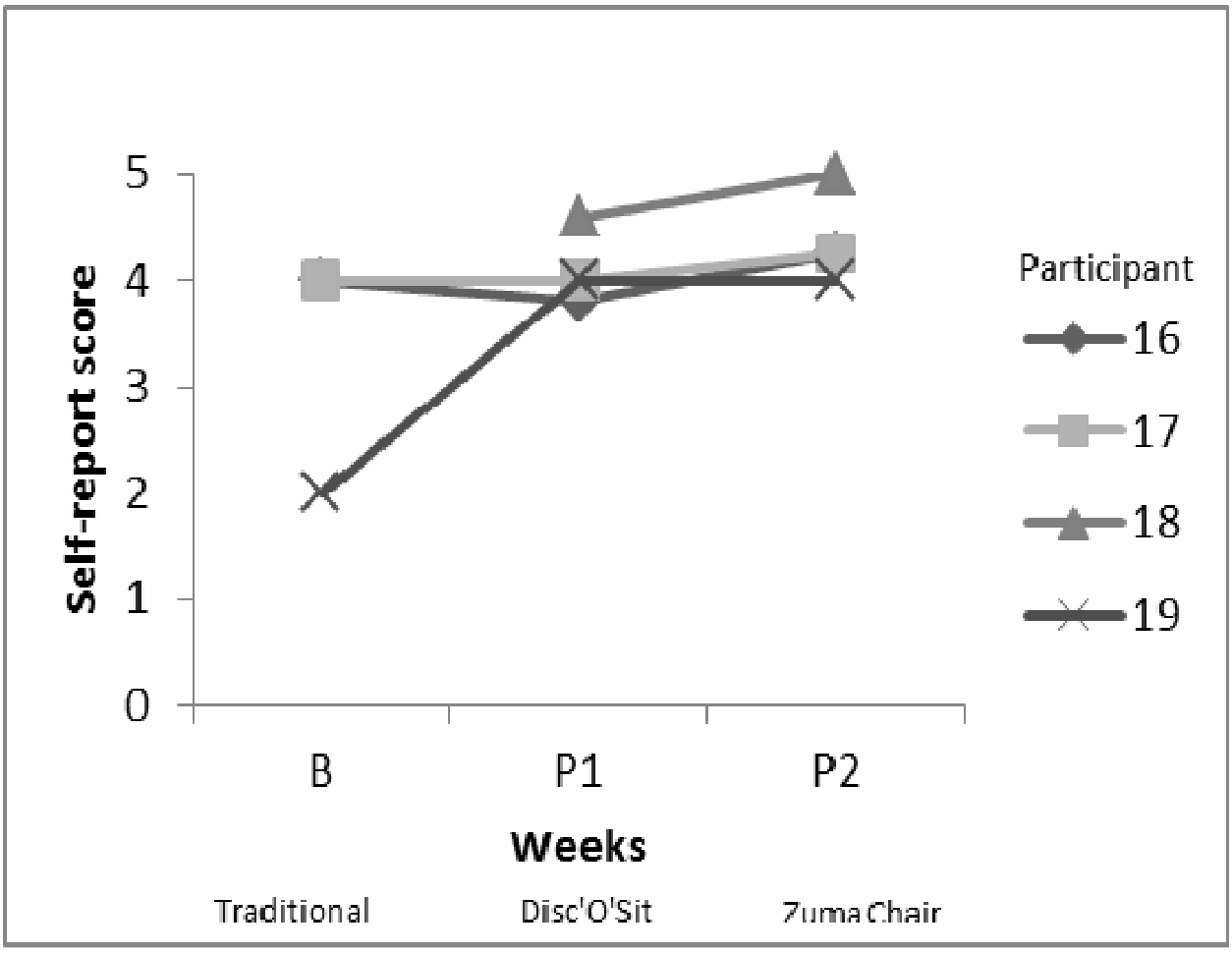

Figure 11. Rankings from Rubric for Group 1 on Attention Across Types of Furniture

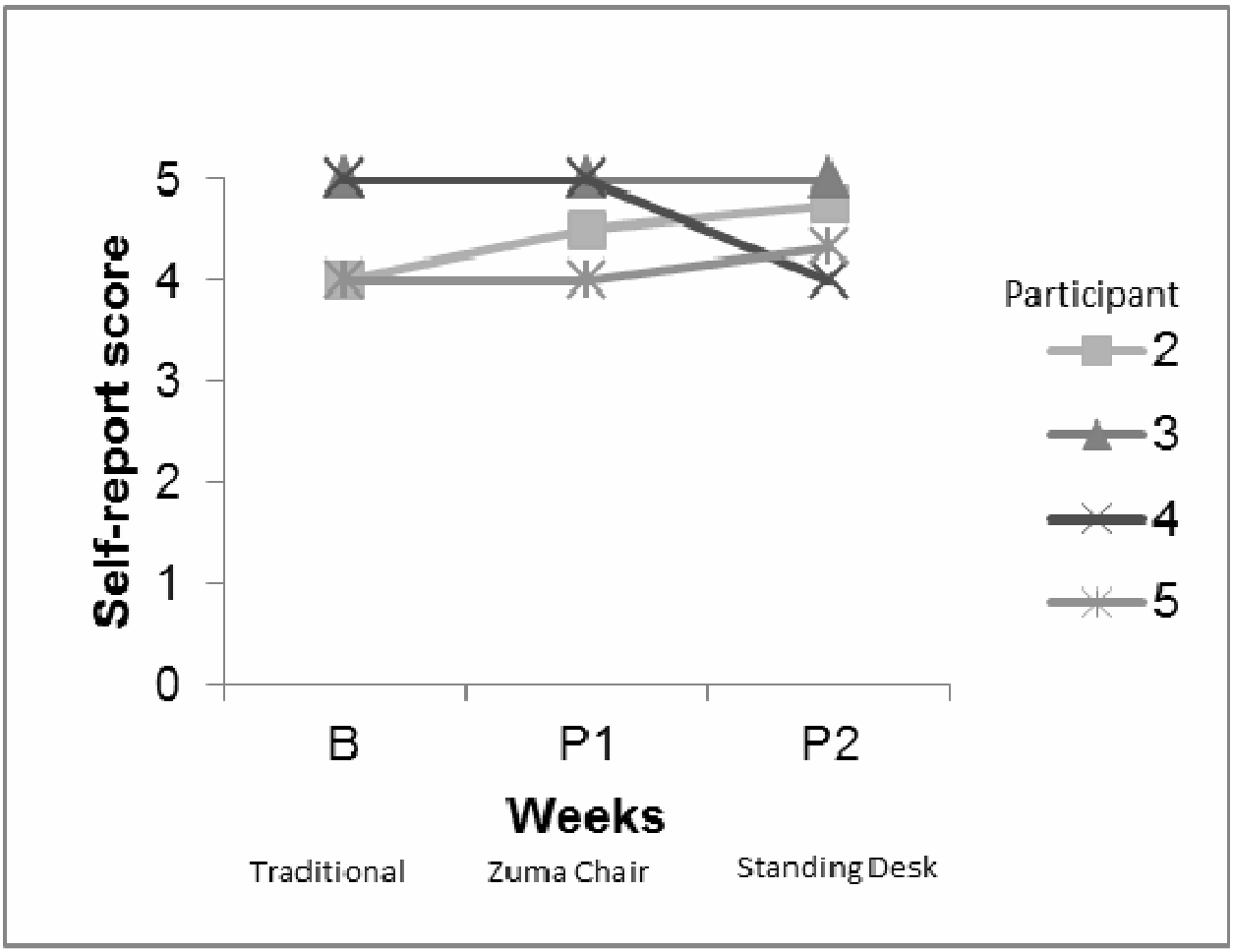

Figure 12. Rankings from Rubric for Group 2 on Attention Across Types of Furniture

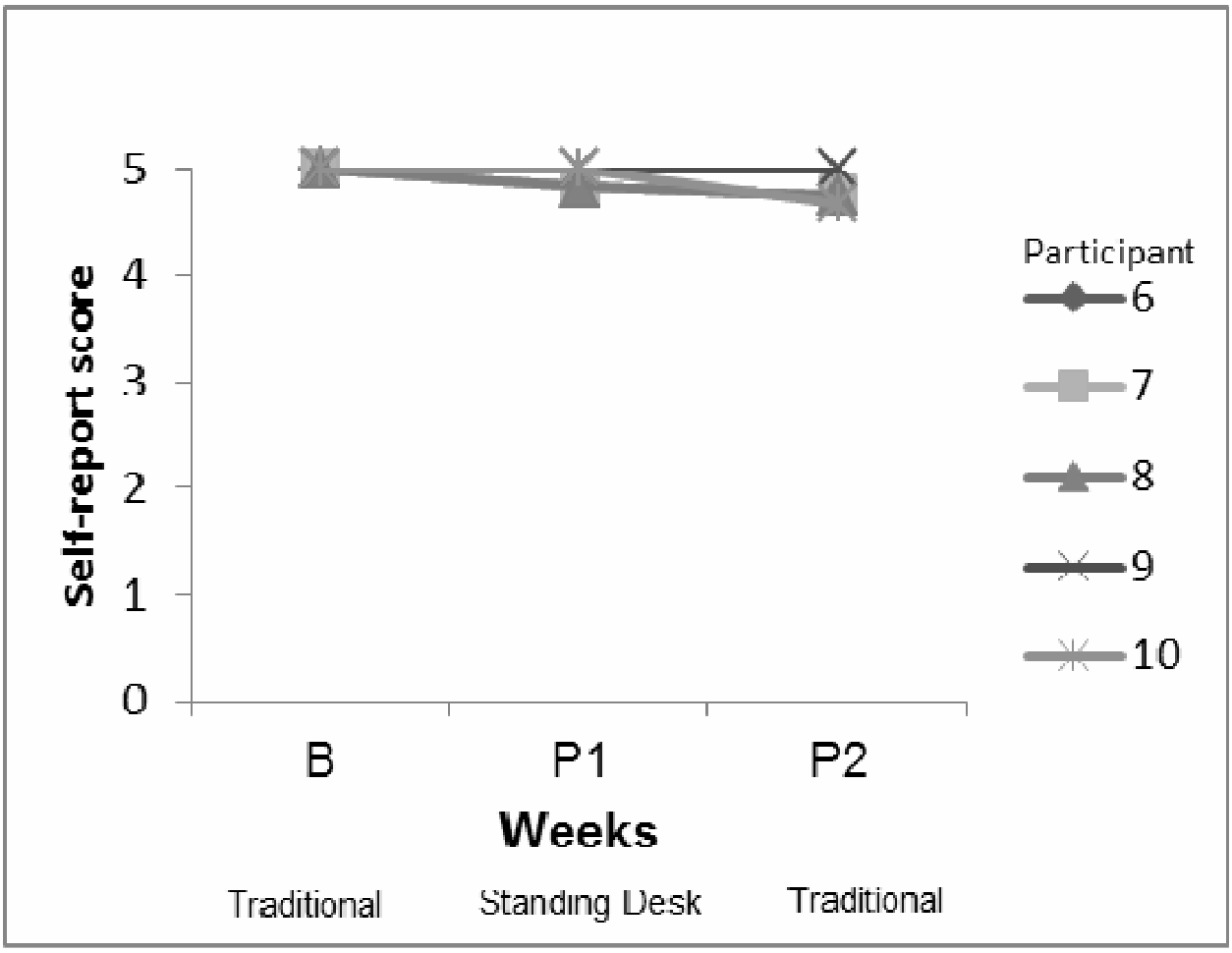

Figure 13. Rankings from Rubric for Group 3 on Attention Across Types of Furniture

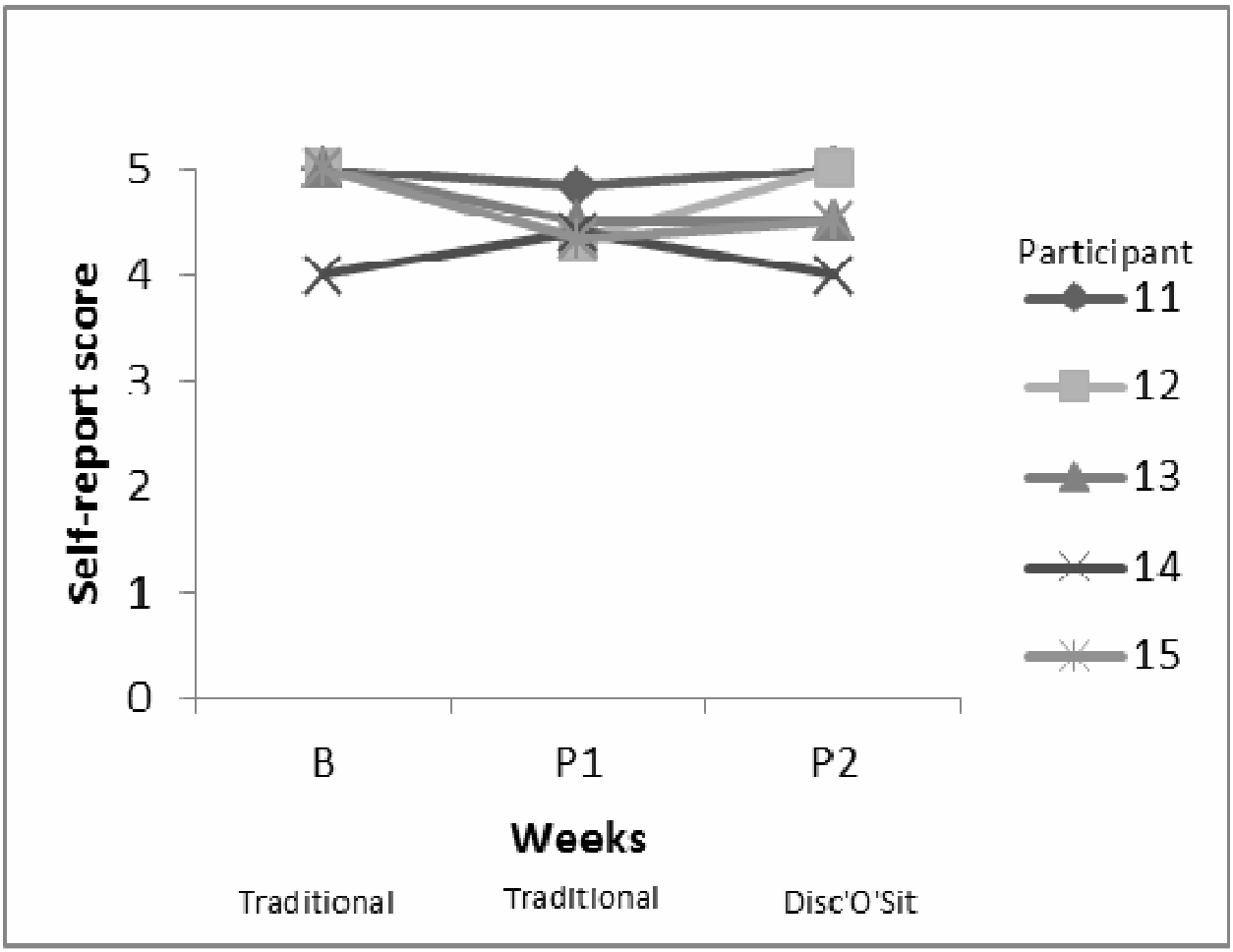

Figure 14. Rankings from Rubric for Group 4 on Attention Across Types of Furniture