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Do You Want Your Students to Pay More Attention in Class? Try Dynamic Seating!

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Abstract

Background: A number of studies have examined dynamic seating in the classroom as a practical, low-cost, and effective strategy to allow students to accumulate light-intensity physical activity, improve the instructional atmosphere and increase academic performance in students. One outcome of interest associated with student learning and subsequent academic performance is attention.

Purpose: To provide insight into the "state of affairs" of the classroom-based dynamic seating literature that has been published with a specific emphasis on improving attention among students. Strengths and limitations of the work are discussed and future directions are highlighted.

Findings: To our knowledge, only five studies have investigated the effect of classroom-based dynamic seating on the academic-related outcome of attention. Evidence supports the use of classroom-based dynamic seating to improve the attention of students.

Conclusion: The integration of dynamic seating in the classroom may be an attractive alternative to traditional seating options with benefits for increasing attention among students. However, studies need to be replicated with larger sample sizes, adequate power, and more rigorous experimental designs before definitive conclusions can be drawn.

Keywords: Dynamic seating; Classroom-based; Alternative workstations; Students; Attention

Background

School administrators are often faced with understanding the demands of the school environment in order to increase the academic achievement of school children. According to an ecological systems perspective, predictors for academic performance are influenced by a dynamic interplay of person characteristics and environmental conditions [1]. This perspective suggests contextual factors (i.e., classroom climate, classroom quality, and student-teacher relationships) interact with person characteristics to influence the educational, social, and behavioural performance of students across the general population [2]. Classrooms with high instructional quality and positive classroom climate have consistently been found to result in greater student engagement and academic achievement [2]. Scientific research is required to guide educational decisions regarding teaching and learning approaches, management strategies, and interventions to maximize classroom performance and behaviour.

Physical activity (PA) has been shown to favourably influence brain plasticity by facilitating neurogenerative, neuroadaptive, and neuroprotective processes, and to enhance cognitive performance, executive functioning, and some types of learning [3]. A growing body of research has indicated that PA is positively associated with academic performance outcomes in children, including classroom behaviour, cognitive skills and attitudes, and academic achievement [4-6]. Hence, the potential of classroom-based PA to increase PA and improve academic-related outcomes, such as classroom behaviour, cognitive performance, and academic achievement among children has gained interest among researchers and educators. Classroom-based PA has been defined as PA carried out during regular class time, which can occur either inside or outside the classroom, in the form of active breaks or physically active lessons [7]. Interventions designed to incorporate movement into the classroom environment may be beneficial for learning because the children have an opportunity to expend excess energy through PA while maintaining academic engagement and cognitive focus on classroom tasks [8].

Recently, Watson and colleagues [7] evaluated the impact of 39 classroom-based PA interventions on academic-related outcomes. Findings indicated that classroom-based PA had a positive effect on improving on-task and reducing off-task classroom behaviour and led to improvements in academic achievement. Hence, classroom-based PA interventions may be an effective approach to improve academic-related outcomes, however, a number of issues with this approach exist. The integration of structured, aerobic PA into the classroom on a regular basis is a very robust approach, which requires planning on behalf of the teacher, successful implementation, as well as potentially considerable time, equipment, and/or cost.

In addition to structured classroom-based PA, another strategy that has been used to improve academic performance is alternative dynamic seating devices. Dynamic seating has been defined as any device or alteration made to traditional classroom seating that allows movement while sitting [9]. These seating devices typically require less

PA movement and energy expenditure, and hence may be less disruptive to the classroom learning environment. There is some evidence that light-intensity levels of PA from dynamic seating are positively related to academic behaviour [10]. Over the past few years, there have been a number of studies conducted to explore the effects of dynamic seating (e.g., standing desks, stability balls, therapy cushions, and cycling desks) versus standard classroom seating on academic-related outcomes [8,11-13]. One outcome of interest that is associated with student learning and subsequent academic performance is attention. Pfeiffer and colleagues have proposed that children innately can learn more effectively if they are able to attend to the task and absorb the information [14]. Attention has been defined as "the process of consciously focusing on relevant stimuli while blocking out irrelevant stimuli" [15]. The impact of dynamic seating interventions on attention of students merits investigation for a number of reasons. First, children in traditional seated classrooms have been reported to spend approximately 97% of their day seated, which can lead to decreased stimulation [16]. These periods of prolonged sitting may result in decreased attention due to the body experiencing less proprioceptive and kinaesthetic feedback [14]. Second, some types of dynamic seating have been shown to elicit more sensory input through the vestibular and proprioceptive systems compared with traditional seated desk and chairs, thereby improving sensory processing which influences the ability to learn [17]. Third and finally, dynamic seating may provide increased opportunity for light-intensity PA and movement, which is positively associated with student attention [18]. To our knowledge, only five studies have investigated the effect of classroom-based dynamic seating on the academic-related outcome of attention [14,19-22]. In the following pages, the reader is provided with detailed insight into the "state of affairs" of the classroom-based dynamic seating literature that has been published with a specific emphasis on improving attention among students.

Classroom-based Dynamic Seating and Attention

Pfeiffer and colleagues [14] had thirty-one elementary school grade 2 students with attention difficulties use a Disc 'O' Sit cushion on their chair for 2 hours per day for a 2-week period. Thirty-two students served as normal chair controls. Attention was assessed using the Behavioural Rating Inventory of Executive Function (BRIEF) pre and post intervention. The BRIEF consists of two indexes: the Behavioural Regulation Index (BRI) and the Metacognition Index (MI). The Global Executive Composite (GEC) is the combined score of both indexes. A significant difference was found in the percentage of change between the treatment and control group for the BRI ($p<0.05$), MI ($p<0.05$), and GEC ($p<0.05$) where the percentage of change in the pre-test and post-test mean scores for the treatment group decreased significantly when compared with the control group (i.e., attention improved for the treatment group).

Fedewa and Erwin [19] gave seventy-six elementary school grade 4 & 5 students (8 with attention and hyperactivity concerns) stability balls in the classroom for 12 weeks. Attention was evaluated by the Attention-Deficit/ Hyperactivity Disorder Test (ADHDT) two weeks before and two weeks after the intervention. For the general classroom, although not statistically significant, ADHDT scores dropped to an average score of 66 from 70. For the 8 students with heightened levels of attention and hyperactivity, ADHDT post scores had significantly ($p< .001$) decreased 2 weeks after the intervention, with a mean quotient of 104 from 123.

Gaston and colleagues [20] presented twenty-three elementary school grade 2 students with stability balls in the classroom for 5 months. Eighteen students remained as normal chair controls. Attention was determined using the National Initiative for Children's Healthcare Quality (NICHQ) Vanderbilt Assessment Scale at baseline, 8 weeks, and 5 months. When compared to baseline scores for attention, there was a significant improvement at time point 2 (8 weeks of intervention, $p=0.000$) and at the end of the intervention at time point 3 (5 months of intervention, $p=-.035$). For both time-points, the experimental group had significantly lower inattention scores (i.e., displayed improved attention) compared to the control group.

Torbeyns and colleagues [21] directed twenty-one high school 3rd and 4th grade students to use cycling desks for 4 class hours (4 x 50 minutes) per week for 5 months. Twenty-three students were normal chair controls. Attention was measured using the Stroop Test (Selective Attention), Rosvold Continuous Performance Test (Sustained Attention) and Longitudinal Research in Secondary Education Attention Questionnaire (Attention During Class) at baseline and following the intervention. No significant attention differences were found ($p>0.05$) except the Stroop test word incongruent stimulus was significantly more accurate following the intervention for the intervention group ($p<0.05$).

Smith and colleagues [22] asked twenty university students to use a normal chair, stability ball chair, and standing desk in a random order for 50 minutes each. The counterbalanced design allowed participants to serve as their own controls. Attention was assessed using the Go/No-go task following each condition. There was no significant difference in the speed of the Go/No-go task between conditions ($p>0.05$). There was a significant difference in the Go/No-Go task accuracy between the classic sitting and standing desks, where the participants performed the Go/No-Go test more accurately while using the standing desk ($p<0.05$). However, there was no significant difference between the dynamic sitting and the other two desks ($p>0.05$). Although not significant, participants performed the Go/No-Go task quicker and more accurately using the dynamic sitting desk over the classic sitting desk.

Discussion

There are several strengths associated with the studies presented above. For instance, they demonstrate that both a single exposure (50 minutes) and long term exposure (5 months) to an alternative workstation may improve attention. They also illustrate that classroom-based dynamic seating may have both health and cognitive (i.e., attention) benefits and highlight that alternative workstations may have an enhanced benefit on the attention of students with attention and hyperactivity difficulties. Furthermore, they show that dynamic seating may improve attention in students of all ages (i.e., elementary to university) using a wide range of attention assessments (i.e., ADHDT, NICHQ, BRIEF, Stroop test, and Go/No-Go test). Finally, they display the ease of implementation of these alternative dynamic seating workstations into real school classrooms.

Despite these strengths, there are a number of limitations that must be acknowledged when interpreting the findings of this body of work. Small sample sizes across the studies ($M=34.2$) limit the generalizability of the findings and only one study [14] reported a formal power analysis completed prior to data collection. The majority of studies ($n=3$) [14,19,20] examined the influence of dynamic seating on attention in elementary school classrooms. However, among these,

one was conducted with grades four and five students and included a subsample of students with attention and hyperactivity concerns [19]; one with general education grade two students [20]; and one among second grade students with attention difficulties [14]. Only two investigations examined the impact of dynamic seating on attention of older students, one among high school students [21] and one with university students [22].

It should also be acknowledged that study designs varied across studies and only two were cluster randomized controlled trials in which classes rather than individuals were randomized into intervention and control groups. Further, the type of dynamic seating integrated into the classroom and length of implementation varied across studies, which limits our ability to determine the most effective dynamic seating device for improving attention levels among students. Specifically, two interventions used stability balls [19,20], one used cycling desks [21], one used therapy cushions [14], and one examined the effects of both stability ball chairs and standing desks [22]. Finally, only one study included an objective measure of PA (i.e., energy expenditure via activity monitor) to assess the impact of the dynamic seating intervention on subsequent PA and to determine intervention fidelity [21]. In summary, there is currently considerable heterogeneity between studies in their design, population examined, type of dynamic seating implemented, assessment of attention, and timelines for intervention implementation and data collection, which prevent definitive conclusions from being made.

A number of future recommendations should be considered with respect to the findings presented herein. First and foremost, studies need to be replicated with larger sample sizes, adequate power, and more rigorous experimental designs that include a comparison or control group. Further investigation surrounding the feasibility and benefits of dynamic seating for improving students' attention in tertiary education settings, including high school and university classrooms, is required. Additional studies are also needed to further examine the effect of dynamic seating devices on attention levels among general education students and across a wider age range of students in the elementary school setting. Among the five studies discussed, four different types of dynamic seating were investigated. It is imperative that these studies be replicated in order to ascertain the effect of these alternative seating devices on students' attention. Given the proposed mechanisms by which dynamic seating may improve attention among students, it is recommended for future interventions in this field of inquiry to examine mechanisms of change (neurocognitive processes) as well as intervention fidelity (i.e., changes in energy expenditure and light-intensity PA as a result of dynamic seating). Consistent with recommendations made by Watson and colleagues [7], researchers are encouraged to use a standardized measure of attention with established validity and reliability to allow for comparisons between studies to be made. The impact of dynamic seating devices on different types of attention (i.e., selective attention *vs.* sustained attention; objective assessment *vs.* teacher-reported) also warrants further investigation. Finally, no studies have investigated the impact of a classroom-based dynamic seating intervention over the course of a full school year. Fedewa and Erwin [19] emphasized the importance of including multiple assessments of attention over a longer duration to determine whether the beneficial effects of the intervention can be maintained.

In conclusion, the integration of dynamic seating in the classroom may be an attractive alternative to traditional seating options with benefits for increasing attention among students; however, additional research is needed before large-scale implementation of dynamic seating as an evidence-based approach takes place. Nonetheless, dynamic seating shows promise as classroom-based intervention to improve attention among students.

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