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Standing and Dynamic Sitting in the University Classroom

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Abstract

Students almost exclusively sit in class, which translates to large amounts of forced sedentary behaviour and this in turn may have negative health consequences. The effect alternative postures have on classroom performance of university students remains unknown.

Using a randomized counterbalanced design, pilot study 1 (N=40) and 2 (N=20) investigated the effect of alternative postures on 3-minute and 50-minute classroom performance, respectively. In study 3, university students' (N=1005) and faculty (N=218) acceptability to alternative workstations in the university classroom was assessed using a mixed method approach.

This thesis provides preliminary evidence that there is no difference between classic sitting, dynamic sitting, and standing desks on classroom performance of university students. Further, implementation of alternative workstations is supported by students and to a lesser extent faculty.

Hence, at this early stage of inquiry there is no evidence to recommend against providing dynamic sitting, sit-stand and standing options in university classrooms.

Keywords:

University; Student; Sedentary; Learning; Cognition; Acceptability; Intervention; Standing; Sit-Stand; Dynamic Sitting

Co-Authorship Statement:

Chapter 2: Standing and Dynamic Sitting in the University Classroom – A Pilot Study

Siobhan T. Smith – Designed study, completed ethics, recruited participants, collected data, analyzed data, and wrote manuscript

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Chapter 3: Standing and Dynamic Sitting: Effects on University Classroom Performance - A Pilot Study

Siobhan T. Smith - Designed study, completed ethics, recruited participants, collected data, analyzed data, and wrote manuscript

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Chapter 4: Standing and Dynamic Sitting in the University Classroom: Perceptions of Students and Faculty

Siobhan T. Smith - Designed study, completed ethics, recruited participants, collected data, analyzed data, and wrote manuscript

Sarah Deck – Assisted in qualitative data analysis and editing

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All authors have approved this thesis. The authors declare that they have no conflict of interest.

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If time fly's when your having fun then I was definitely having fun these past two years.

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"When one door closes another opens. I can't wait to see what lies behind it" (anonymous).

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CHAPTER 1: Introduction

What is Sedentary Behavior?

Sedentary behavior (SB) is any waking behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture (Sedentary Behaviour Research Network, 2012). METs are a measure of energy expenditure and oxygen uptake, where one MET is equal to ~1kcal/kg/h and ~3.5mlO_2/kg/min. The energy expenditure continuum (Figure 1) illustrates SB as ≤ 1.5 METs, light physical activity (PA) as >1.5 and <3.0 METs, moderate PA as ≥3.0 and <6.0 METs, and vigorous PA as ≥6.0 METs (Sedentary Behaviour Research Network, 2012).

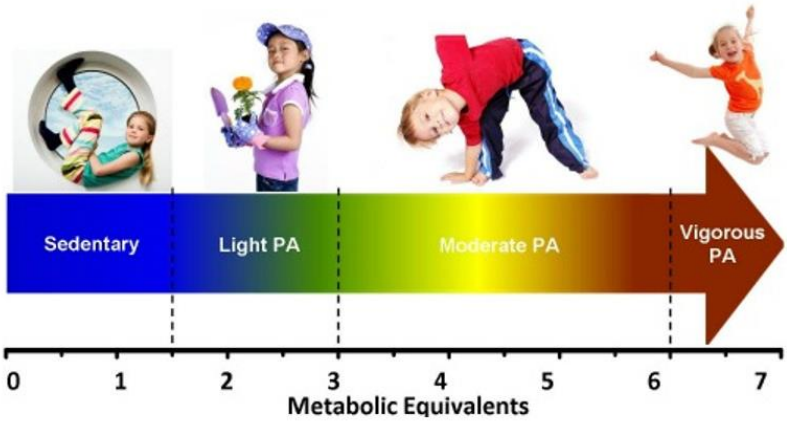

Figure 1. Energy Expenditure Continuum (SB Research Network, 2012)

Being sedentary is not the same as being inactive. A sedentary individual has a low non-exercise activity thermogenesis (NEAT), whereas an inactive individual has a low exercise activity thermogenesis (EAT) in their daily energy expenditure (Figure 2).

NEAT is the energy expended that is not from sleeping, eating, or planned exercise. For instance, NEAT would include cleaning, carrying groceries, walking to work, and playing with your pet. Whereas, EAT is more planned and often more vigorous. For example, EAT would include going for a run, playing soccer, and lifting weights. To maximize positive health outcomes, it is important to both reduce SB (increase NEAT) and increase PA (increase EAT), as SB is an independent and unique entity from PA (Figure 2).

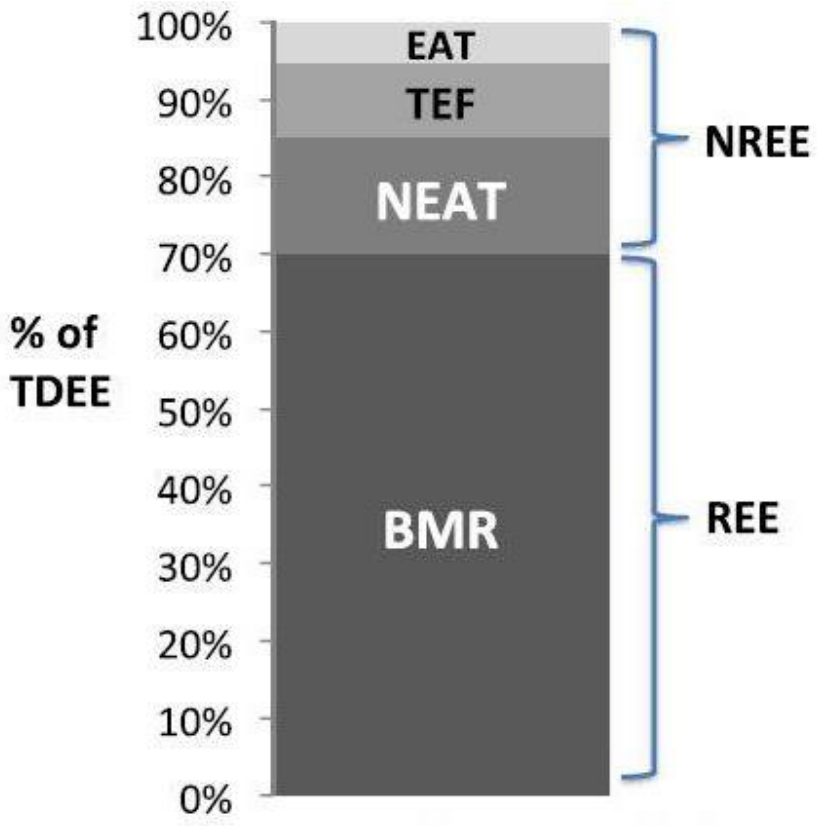

Figure 2. Components of Total Daily Energy Expenditures (Trexler et al, 2014)

Note. BMR = basal metabolic rate; NEAT = non-exercise activity thermogenesis; TEF = thermic effect of food; EAT = exercise activity thermogenesis; REE = resting energy expenditure; NREE = non-resting energy expenditure

How Much Do We Sit?

The average Canadian adult is sedentary for approximately 9.5 hours of their waking day (Statistics Canada, 2013). These SB trends are not only present in Canada, as they have been documented in several different countries (Ng & Popkin, 2012). Certain populations, such as university students are even more sedentary. University students spend more than 11 hours per day being sedentary (Cotten & Prapavessis, 2016; Prapavessis et al., 2015; Wong et al., 2016). These high levels of SB are concerning but not surprising, as currently many individuals sit for behaviours, such as transportation, work and/or school, and leisure activities (i.e., reading, watching television).

What are the Health Consequences of Excessive Sedentary Behavior?

Increased SB, independent of moderate-to-vigorous physical activity (MVPA), is well established to be a risk factor for many health problems, including but not limited to: diabetes, cardiovascular disease, cancer, and depression (Lee & Wong, 2015; Schmid & Leitzmann, 2014; Teychenne et al., 2010; Wilmot et al., 2012). Further, Ekelund et al., (2016) with a sample of more than 1 million men and women found that individuals need to accumulate 60-75 minutes of daily MVPA to eliminate the risk of all-cause mortality, only if daily sitting time does not exceed 8 hours per day. Thus, both reducing SB and increasing PA should be a health priority.

How to Reduce Sedentary Behavior?

Both behavioral and environmental interventions to reduce sedentary time have received a substantial amount of research attention over the past 10 years.

Behavioral interventions include a prompt or reminder to break up prolonged SB. Examples of behavioral components of interventions to reduce SB include text-based

messages (Bond et al., 2014; Cotten & Prapavessis, 2016), telephone calls (Healy et al., 2013), email reminders (Chau et al., 2016), and providing feedback regarding the amount of time spent sedentary and active (Hendriksen et al., 2016; Torbeyns et al., 2016).

Environmental interventions are designed to break up SB for their entire duration. Examples of environmental changes are the use of a standing desk, dynamic sitting chair (i.e. sit in a more active way: chairs without back support, unstable chairs, exercise balls, etc.), and other environmental workplace designs that promote less SB throughout the day (Gorman et al., 2013).

It has been shown that interventions with a focus on SB as opposed to PA or PA and SB combined, produced consistent, large, and meaningful reductions in SB (Prince et al., 2014). Further, interventions designed with the primary aim of reducing SB rather than increasing PA show the most promise for reducing SB (Gardner et al., 2016). Researchers have also concluded that environmental restructuring was one of the more promising intervention designs (i.e, Gardner et al., 2016). Additionally, a systematic review examining the effect of work site environmental interventions on SB concluded that environmental workplace modalities were largely successful at reducing SB (Hutcheson et al., 2016).

This research conducted on workplace environmental interventions demonstrates that dynamic sitting chairs, such as the stability ball desk (Beers et al., 2008), sit-stand workstations (Graves et al., 2015), active treadmill workstations (Cao et al., 2016), cycling workstations (Torbeyns et al., 2016) and active elliptical workstations (Botter et al., 2016) have been shown to improve body composition (e.g., weight; Torbeyns et al.,

2016) and metabolic profiles (e.g., blood glucose levels; Graves et al., 2015) as well as increase energy expenditure (Beers et al., 2008; Botter el al., 2016; Cao et al., 2016). Overall, alternative workstations have the potential for substantial health benefits.

How Much Should We Sit?

Canada and many countries around the world are starting to add research based SB directions to their health guidelines (CSEP, 2017). Canada recently created 24-hour movement guidelines for children 0-4 years (move, sleep, sit) and 5-17 (sweat, step, sleep, sit) that includes SB recommendations (see figure 3; CSEP, 2017). For example, infants (<1 year old), toddlers (1-2 years), and preschoolers (3-4 years) should not be restrained or sit for more than 1 hour at a time and when sedentary engaging in pursuits such as reading with a caregiver is encouraged (CSEP, 2017). Further, for those <2 years screen time is not recommended and for those 2-4 years screen time should be no more than 1 hour, less is better (CSEP, 2017). Additionally, children 5-17 years should have no more than 2 hours per day of recreational screen time and should limit sitting for extended periods (CSEP, 2017).

Figure 3. 24-hour guidelines for children 0-4 (Move, Sleep, Sit) and 5-17 (Sweat, Step, Sleep, Sit) years respectively (CSEP, 2017)

Unfortunately, SB guidelines for adults (18-64) and older adults (65 years and older) have not yet been released in Canada. However, guidelines from Australia and the United Kingdom recommends SB should be minimized and extended periods of SB should be broken up as frequently as possible for adults (Australian Government, 2017; UK Government, 2011).

What are the Effects of Environmental Interventions on Productivity and Performance?

A major concern with these environmental interventions is that both performance and productivity will be reduced. However, recent systematic reviews concluded that sit-stand and active workstations used by office workers do not cause a decrease in productivity or performance (Cao et al., 2016; Commissaris et al., 2016; Karakolis &

Callaghan, 2014; Karol, 2015; MacEwen et al., 2015; Neuhaus et al., 2014; Torbeyns et al., 2014; Tudor-Locke et al., 2014).

In school settings, the effects of standing desks within the primary/elementary classrooms found increased energy expenditure, reduced SB, and most importantly, no detrimental effects on classroom behavior and learning (Castellucci et al., 2017; Sherry et al., 2016). Researchers have begun to stress the importance of assessing these interventions with both secondary/high school and college/university students, as reducing SB is needed throughout the life course to help reduce (or prevent) the health risks associated with long bouts of sitting (Sherry et al., 2016). Experimental evidence is warranted to show that performance in the university classroom is not compromised by the introduction of standing and dynamic sitting postures to reduce sedentary behavior. Hence, the primary purpose of this thesis was to investigate the classroom performance effect and perceptions of alternative postures in the university classroom.

References

Australian Government, The Department of Health. Australia's Physical Activity and Sedentary Behaviour Guidelines. Retrieved from http://www.health.gov.au/internet/main/publishing.nsf/content/health-pubhlth-strateg-phys-act-guidelines

Beers, E. A., Roemmich, J. N., Epstein, L. H., & Horvath, P. J. (2008). Increasing passive energy expenditure during clerical work. *European Journal of Applied Physiology*, 103(3), 353-360. DOI: 10.1007/s00421-008-0713-y.

Bond, D. S., Thomas, J. T., Raynor, H. A., Moon, J., Sieling, J., Trautvetter, J., … Wing, R.R. (2014). B-MOBILE – a smartphone-based intervention to reduce sedentary time in overweight/ obese individuals: a within-subjects experimental trial. *Plos One*, 9(6), 100821. DOI: 10.1371/journal.pone.0100821

Botter, J., Ellegast, R. P., Burford, E. M., Weber, B., Konemann, R., & Commissaris, D. A. C. M. (2016). Comparison of the postural and physiological effects of two dynamic workstations to conventional sitting and standing workstations. *Ergonomics*, 59(3), 449-463. DOI: 10.1080/00140139.2015.1080861

Cao, C., Liu, Y., Zhu, W., Ma, J. (2016). Effect of active workstation on energy expenditure and job performance: a systematic review and meta-analysis. *Journal of Physical Activity and Health*, 13(5), 562-571. DOI: 10.1016/j.apergo.2014.05.003

Castellucci, H. A., Arezes, P. M., Molenbroek, J. F. M., de Bruin, R., & Viviani, C. (2017). The influence of school furniture on students' performance and physical

responses: results of a systematic review. *Ergonomics*, 60(1), 93-110. DOI: 10.1080/00140139.2016.1170889

Commissaris, D. A., Huysmans, M. A., Mathiassen, S. E., Srinivasan, D., Koppes, L. L., & Hendriksen, I. J. (2016). Interventions to reduce sedentary behavior and increase physical activity during productive work: a systematic review. *Scandiavian Journal of Work Environment and Health, 42*(3), 181-191. DOI: 10.5271/sjweh.3544

Cotten, E., & Prapavessis, H. (2016). Increasing nonsedentary behaviors in university students using text messages: randomized controlled trial. *JMIR MHealth and UHealth*, 4(3), 99. DOI: 10.2196/mhealth.5411

Chau, J. Y., Sukala, W., Fedel, F., Do, A., Engelen, L., Kingham, M., Sainsbury, A., & Bauman, A. E. (2016). More standing and just as productive: Effects of a sit-stand desk intervention on call center workers sitting, standing, and productivity at work in the opt to stand pilot study. *Preventative Medicine Reports*, 3(1), 68-74. DOI: 10.1016/j.pmedr.2015.12.003

CSEP. CSEP guidelines. Retrieved from http://www.csep.ca/en/guidelines/links-to-csep-guidelines

Ekelund, U., Steene-Johannessen, J., Brown, W. J., Fagerland, M. W., Owen, N., Powell, K. E., … Lee, I. M. (2016). Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonized meta-analysis of data from more than 1 million men and women. *Lancet,* 388, 1302-1310. DOI: http://dx.doi.org/10.1016/ S0140-6736(16)30370-1

Gardner, B., Smith, L., Lorencatto, F., Hamer, M., & Biddle, S. J. H. (2016). How to reduce sitting time? A review of behaviour change strategies used in sedentary behaviour reduction interventions among adults. *Health psychology Reviews*, *10*(1), 89-112. DOI: 10.1080/17437199.2015.1082146

Gorman, E., Ashe, M. C., Dunstan, D. W., Hanson, H. M., Madden, K., Winkler, E. A. H., … Healy, G.N. (2013). Does an activity-permissive workplace change office workers sitting and activity time?. *Plos One*, 8(10), 76723. DOI: 10.1371/journal.pone.0076723

Graves, L. E. F., Murphy, R. C., Shepherd, S. O., Cabot, J., & Hopkins, N. D. (2015). Evaluation of sit-stand workstations in an office setting: a randomized controlled trial. *Public Health*, 15(1), 1145. DOI: 10.1186/s12889-015-2469-8

Healy, G. N., Eakin, E. G., Lamontagne, A. D., Owen, N. Winkler, E. A. H., Wiesner, G., … Dunstan, D. W. (2013). Reducing sitting time in office workers: short-term efficacy of a multicomponent intervention. *Preventative Medicine*, 57(1), 43-48. DOI: 10.1016/j.ypmed.2013.04.004

Hendriksen, I. J. M., Bernaards, C. M., Steijn, W. M. P., & Hildebrandt, V. H. (2016). Longitudinal relationship between sitting time on a working day and vitality, work performance, presenteeism, and sickness absence. *Journal of Occupational and Environmental Medicine*, 58(8), 784-789. DOI: 10.1097/JOM.0000000000000809

Hutcheson, A. K., Piazza, A. A., & Knowlden, A. P. (2016). Work Site-Based Environmental Interventions to Reduce Sedentary Behavior: A Systematic

Review. *American Journal of Health Promotion, 32*(1), 32-47. DOI: 10.1177/0890117116674681

Karakolis, T., & Callaghan, J. P. (2014). The impact of sit-stand office workstations on worker discomfort and productivity: a review. *Applied Ergonomics,* 45(3), 799-806. DOI: 10.1016/j.apergo.2013.10.001

Karol, S. (2015). Implications of sit-stand and active workstations to counteract the adverse effects of sedentary work: A comprehensive review. *Work, 52*(2), 255-267. DOI: 10.3233/WOR-152168

Lee, P. H., & Wong, K. Y. (2015). The association between time spend in sedentary behaviors and blood pressure: a systematic review and meta-analysis. *Sports Medicine,* 45(6), 867- 880. DOI: 10.1007/s40279-015-0322-y

MacEwen, B. T., MacDonald, D. J., & Burr, J. F. (2015). A systematic review of standing and treadmill desks in the workplace. *Preventative Medicine, 70, 50-58.* DOI: https://doi.org/10.1016/j.ypmed.2014.11.011

Neuhaus, M., Healy, G. N., Dunstan, D. W., Owen, N., & Eakin, E. G. (2014). Workplace sitting and height adjustable workstations a randomized controlled trial. *American Journal of Preventative Medicine,* 46(1), 30-40. DOI: 10.1016/j.amerpre.2013.09.009

Ng, S. W., & Popkin, B. M. (2012). Time use and physical activity: a shift away from movement across the globe. *Obesity Review,* 13, 659-680. DOI: 10.1111/j.1467-789X.2011.00982.x

Prapavessis, H., Gaston, A., & DeJesus, S. (2015). The Theory of planned behavior as a model for understanding sedentary behavior. *Psychology of Sport and Exercise,*

19, 23-32. DOI: https://doi.org/10.1016/j.psychsport.2015.02.001

Prince, S. A., Saunders, T. J., Gresty, K., & Reid, R. D. (2014). A comparison of the effectiveness of physical activity and sedentary behaviour interventions in reducing sedentary time in adults: A systematic review and meta-analysis of controlled trials. *Obesity Reviews, 15*(11), 905-919. DOI: 10.1111/obr.12215

Schmid, D., & Leitzmann, M. F. (2014). Television viewing and time spent sedentary in relation to cancer risk: a meta-analysis. *Journal of the National Cancer Institute,* 106(7). DOI: 10.1093/jnci/dju098

Sedentary Behaviour Research Network. (2012). *Statement on the Standardized Use of the terms "sedentary" and "sedentary behaviours."* Retrieved from www.sedentarybehaviour.org

Sherry, A. P., Pearson, N., & Clemes, S. A. (2016). The effects of standing desks within the school classroom: a systematic review. *Preventive Medicine Reports,* 3, 338-347. DOI: https://doi.org/10.1016/j.pmedr.2016.03.016

Statistics Canada. (2013). *Directly measured physical activity of adults, 2012 and 2013.* Retrieved from http://www.statcan.gc.ca/pub/82-625-x/2015001/article/14135-eng.htm

Teychenne, M., Ball, K., & Salmon, J. (2010). Sedentary behavior and depression among adults: a review. *International Journal of Behavior Medicine,* 17(4), 246-254. DOI: 10.1007/s12529-010-9075-z

Torbeyns, T., Bailey, S., Boss, I., & Meeusen, R. (2014). Active workstations to fight sedentary behaviour. *Sports Medicine, 44*(9), 1261-1273. DOI: 10.1007/s40279-014-0202-x

Torbeyns, T., de Geus, B., Stephen, B., de Pauw, K., Decroix, L., Van Cutsem, J., & Meeusen, R. (2016). Bike desks in the office: physical health, cognitive function, work engagement, and work performance. *Journal of Occupational and Environmental Medicine,* 58(12), 1257-1263. DOI: 10.1097/JOM.0000000000000911

Tudor-Locke, C., Schuna, J. M. J., Frensham, L. J., & Proenca, M. (2014) Changing the way we work: elevating energy expenditure with workstation alternatives. *International Journal of Obesity*, *38*(6), 755-765. DOI: http://dx.doi.org.proxy1.lib.uwo.ca/10.1038/ijo.2013.223

Trexler, E. T., Smith-Ryan, A. E., & Norton, L. E. (2014). Metabolic adaptation to weight loss: implications for the athlete. *Journal of the International Society of Sports Nutrition, 11(1),* 7. DOI: 10.1186/1550-2783-11-7

UK Government. UK Physical Activity Guidelines. Retrieved from https://www.gov.uk/government/publications/uk-physical-activity-guidelines

Wilmot, E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Gray, L. J., Khunti, … Biddle, S. J. H. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review. *Diabetologia*, 55(11), 2895-2905. DOI: 10.1007/s00125-012-2677-z

Wong, T. S., Gaston, A., DeJesus, S., & Prapavessis, H. (2016). The utility of a protection motivation theory framework for understanding sedentary behavior. *Health psychology and behavioral medicine,* 4(1), 29-48. DOI: http://dx.doi.org/10.1080/21642850.2015.1128333

CHAPTER 2: Standing and Dynamic Sitting: Effects on University Classroom Performance – A Pilot Study

Introduction

It is well established that there are many health risks (obesity, cardiovascular, bone, metabolic, cancer, etc.) associated with prolonged sedentary time (Tremblay et al., 2010). However, research has shown that breaking up long periods of sitting can attenuate these health risks and lead to many health benefits (Dunstan et al., 2012; Cao et al., 2016; Crespo et al., 2016; Graves et al., 2015; Healy et al., 2008). Although breaking up periods of prolonged sitting with standing and light to moderate exercise has health benefits (Dunstan et al., 2012; Crespo et al., 2016; Healy et al., 2008), it is not a universally accepted behavior, particularly in the work place. In addition, it is unclear if standing desks might hinder learning and productivity.

To shed light on this issue, Commissaris et al., (2014) evaluated the effectiveness a series of short (3 to 5 minute) office tasks (e.g., mouse clicking, telephone conversation, and corrective reading) while individuals used various dynamic workstations including a treadmill desk, an elliptical trainer, a bicycle ergometer, and a standing desk. Results showed that the workstation used was not a debilitating factor for the abovementioned office tasks. Although these findings have been supported by some studies (Cao et al., 2016; Karakolis et al., 2014; Straker et al., 2009), other studies on dynamic workstations have shown slower computer task performance (Cao et al., 2016; Funk et al., 2012; Straker et al., 2009). Thus, research on this topic is equivocal at present.

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University students experience excessive periods of sitting time during class and while studying (Moulin, 2016). Furthermore, tasks university students have to perform specifically in the classroom (i.e., listen, record, and recall lecture material) are sufficiently different from those of office workers. Hence, the purpose of this study was to determine the effect of sitting, dynamic sitting, and standing desks on classroom performance of university students.

Methods

Participants

Participants (N=40; Age=20.9±1.4; N male=20) were students of the University of Western Ontario. Participants were primarily Caucasian (N=28) and in the Faculty of Health Science (N=30). Participants were informed of the purpose of the study and they provided written consent to take part in it. The Western University Health Science Research Ethics Board approved this research intervention.

Design, Intervention, and Outcome Measures

Based on a randomization sequence, each participant performed three 3-minute classroom simulations (Figure 1).

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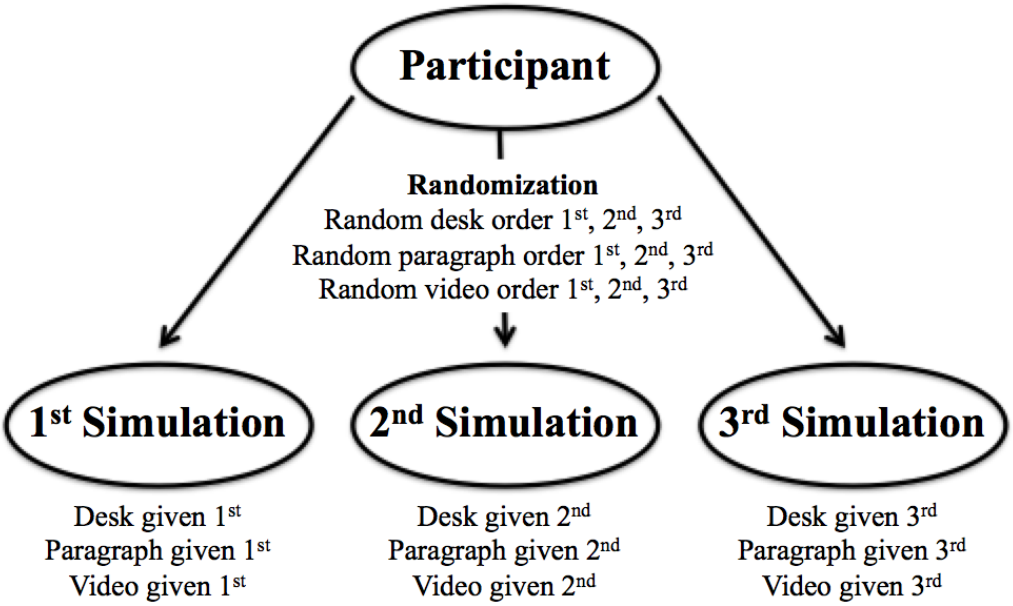

Figure 1. Randomization Sequence Flow Chart

One simulation was performed for each of the three desks: classic sitting, dynamic sitting, and standing. The classic sitting desk is an adjustable computer chair, the dynamic sitting desk resembles a bosu ball on wheels that comes in three sizes, and the standing desk has an adjustable keyboard and computer monitor that can move to any height. On each desk the keyboard and computer monitor were the same. There was no acclimatization period to any of the workstations used.

Each of the three simulations included a different typing task with the same number of words (70) and characters (320) and a different 3-minute video. Participants watched the 3-minute video and at 30 seconds heard the command "go". At this command participants started typing the paragraph displayed to their left as fast and as accurate as possible while still paying attention to the video. Three and 4-minute typing exercises have been used to compare and detect differences in seated and active

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workstations (Cao et al., 2016; Commissaris et al., 2014; Graves et al., 2015). Thus, this length of time is reasonable. The simulation was intended to mimic a university class; students typing displayed notes while listening to a professor lecturing. Following the video participants were asked to answer three multiple-choice questions (a-f) pertaining to the video.

Typing was assessed for speed and accuracy (number of errors) using the following formula: Net Words Per Minute (WPM) = [(All Typed Entries/5) – Uncorrected Errors]/Time (Groeber, 2016)**.** Memory was assessed by participants identifying the correct response to post-video questions.

After completing all the simulations, participants were also asked to verbally rate their experience using each desk from 1-5, 1 being a difficult and unenjoyably experience and 5 being an easy and enjoyable experience.

Statistics

To check the fidelity of the manipulation, one-way repeated measures ANOVAs were used to examine for speed accuracy and WPM and memory differences between the (a) 3 simulation conditions and (b) order of receiving the 3 simulation conditions. For the main results, one-way repeated measures ANOVAs were used to examine for speed-accuracy WPM and memory differences across sitting, dynamic sitting and standing desk conditions. All ANOVAs were accompanied by partial eta square values η^2_p to show effect sizes and the level of significance was set at .05. Descriptive data were presented as mean ± standard deviation (SD).

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Results

Manipulation (Fidelity) Check

Results from the ANOVA show that there are no differences for speed-accuracy between the 3 paragraphs ($F(2,115)=.53$, $p=.59$, $\eta^2_p<.01$) and for memory between the 3 videos ($F(2,117)=.463$, $p=.631$, $\eta^2_p<.01$). Thus, there are no paragraph or video difficulty differences.

Results from the ANOVA also show that there are no differences for speed-accuracy ($F(2,115)=.17$, $p=.85$, $\eta^2_p<.01$) and memory ($F(2,117)=.68$, $p=.51$, $\eta^2_p=.01$) for the simulations order (1, 2, and 3). Thus, there is no learning effect.

Table 1

Typing, memory and self-reported measures with classic sitting, dynamic sitting, and standing

Outcome	Classic Sitting	Dynamic Sitting	Standing
Typing[a]	46.15 (13.62)	45.56 (12.96)	46.30 (15.60)
Memory[b]	1.25 (0.54)	1.30 (0.61)	1.30 (0.61)
Self-Reported Measures[c]	3.90 (1.01)	3.69 (1.08)	3.46 (1.16)

Note. Mean (Standard Deviation)
[a]Typing= words per minute
[b]Memory= number of questions correct
[c]Self-reported measures = rating on 5 point Likert Scale

Primary Outcomes

Typing. There was no significant difference in the speed-accuracy (WPM) for the typing task between the classic sitting, dynamic sitting, and standing desks ($F(2,115)=.03$, $p=.97$, $\eta^2_p<.01$, Table 1).

Memory. There was no significant difference in the number of questions answered correctly for the memory task between the classic sitting, dynamic sitting, and standing desks ($F(2,117)=.10$, $p=.91$, $\eta^2_p<.01$, Table 1).

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Secondary Outcome

Self-reported measures. There was no significant difference in the ratings of the desks in terms of ease and enjoyment between the classic sitting, dynamic sitting, and standing desks ($F(2,117)=1.63$, $p=.20$, $\eta^2_p = .03$, Table 1).

Discussion

This pilot study provides preliminary evidence suggesting that there is no difference between classic sitting, dynamic sitting, and standing desks on classroom performance of university students. There also was no difference in how the desk conditions were rated by participants in terms of ease and enjoyment. The classroom simulation tasks were likely more difficult then the tasks participants would be expected to do on a daily basis in class. Often in class participants are not forced to type as fast and as accurate as possible while listening intently. Thus, easier daily classroom tasks would likely be performed equally well, if not better, using dynamic sitting and standing desk alternatives compared to classic sitting. Overall, our findings are consistent with those reported by Commissaris et al., (2014). Specific tasks for both office workers and university students were performed just as well using standing and dynamic sitting desks when compared to a classic sitting desk (Commissaris et al., 2014).

Straker et al., (2009) also found no significant performance difference in office workers between the sitting and standing desks for standardized computer tasks including a 3-minute typing task. The 3-minute typing task is very comparable to the current study. However, Straker et al., (2009) and Funk et al., (2012) found a significant performance difference in office workers between sitting and treadmill desks for a 3-minute typing task. This is consistent with a 2016 systematic review and meta-analysis

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done by Cao et al., (2016). Cao et al., (2016) concluded that active workstations do not affect selective attention, processing speed, speech quality, reading comprehension interpretation and accuracy of transcription but they could decrease the efficiency of typing speed and mouse clicking. This may be due to increased upper body movement that may hinder finer motor skills. However, Cao et al., (2016) concluded the performance decrease would cause little effect on real-life work productivity. Thus, consistent with current research, to avoid any negative performance effects while still obtaining health benefits, dynamic sitting and standing desks may be a more appropriate option for university students than more dynamic workstations such as treadmill desks.

Strengths with the present study include an investigation that targeted a unique population, university students and performance tasks that were designed specifically for that population. Despite these strengths, there are limitations with the current study that must be acknowledged. First, the classroom performance tasks were performed for only three minutes under each desk condition. Typical university classes' range from 50 minutes to 2.5 hours or 3 hours with 15-30 minutes worth of breaks. Hence, we can only speculate that our findings would hold over longer more realistic class times. Further, it is unknown if over the 50 minute class period students will experience any discomfort from using the dynamic sitting or standing desks. It is recommended that future work examine performance and discomfort issues over a longer more ecologically valid class period. A null finding will aid in the recommendation and implementation of dynamic sitting and standing desks in university classrooms thus, allowing university students to obtain health benefits as they learn. In non-class settings, Drury et al., (2008) showed no performance effects between sitting and standing X-ray baggage screening over 40

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minutes and Beers et al., (2008) showed no difference in clerical work over 20 minute period between office chairs, therapy balls, and standing desks.

The sit and stand method appears to offer a viable approach for investigating performance during longer classroom times. Ebara et al., (2008) for instance, found no significant difference between the sitting and the sit-stand conditions over 150 minutes of transcription. Further, Husemann et al., (2009) found no decrease in productivity for typing 4 hours a day for 5 days. Additionally, a review by Karakolis et al., (2014) also concluded that sit-stand workstations are likely effective in reducing perceived discomfort and do not cause a decrease in productivity in office workers. Sit-stand workstations have been shown to significantly reduce daily sitting time and lead to beneficial improvements in cardiometabolic risk parameters in asymptomatic office workers (Graves et al., 2015). These findings imply that prolonged use of sit-stand workstations may have important ramifications for the prevention and reduction of cardiometabolic risk in a large portion of the population, including university students.

Another method to apply to longer periods of class time is the dynamic sitting desk. Beers et al., (2008) for example, showed that the willingness to perform clerical work was equal to the office chair and greater ($p \leq .05$) for the therapy ball than standing yet there was no significant difference in energy expenditure between therapy ball and standing postures ($p > .48$). In the present study, participants showed no significant difference ($p > .05$) in their ease and enjoyment ratings of the three desks. However, over a longer period of time the standing desk might cause some discomfort.

In addition to maintaining productivity, standing may have an effect on mood. Pronk et al., (2012) showed significant improvements after a 5-week sit-stand desk

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intervention in fatigue, vigor, tension, confusion, depression, and total mood disturbance. Results indicated participants felt more comfortable, energized, healthy, focused, productive, happy, and less stressed after using the sit-stand workstation (Husemann et al., 2009). Perhaps these positive mood effects would occur to students switching from a sitting desk as well. Future work needs to investigate the potential positive mood effects of alternative desks on university students, as mental health is an ongoing problem at most universities (Storrie et al., 2010).

Conclusion

This pilot study provides preliminary evidence suggesting that there is no difference between classic sitting, dynamic sitting, and standing desks on classroom performance of university students. Furthermore, those participants rated the desks equally on ease and enjoyment. These findings need to be replicated over longer more realistic class times before we can recommend the use of standing and/or dynamic sitting in university classrooms.

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References

Beers, E. A., Roemmich, J. N., Epstein, L. H., & Horvath, P. J. (2008). Increasing passive energy expenditure during clerical work. *European Journal of Applied Physiology*, 103(3), 353-360. DOI: 10.1007/s00421-008-0713-y.

Cao, C., Liu, Y., Zhu, W., Ma, J. (2016). Effect of active workstation on energy expenditure and job performance: a systematic review and meta-analysis. *Journal of Physical Activity and Health*, 13(5), 562-571. DOI: 10.1016/j.apergo.2014.05.003

Commissaris, D. A. C. M., Konemann, R., Mastrigt, S. H., Burford, E. M., Botter, J. Douwes, M., & Ellegast, R. P. (2014). Effects of a standing and three dynamic workstations on computer task performance and cognitive function tests. *Applied Ergonomics*, 45(6), 1570-1578. DOI: 10.1016/j.apergo.2014.05.003

Crespo, N. C., Mullane, S. L., Zeigler, Z. S., Buman, M. P., & Gaesser, G. A. (2016). Effects of standing and light-intensity walking and cycling on 24-h glucose. *Medicine and science in sports and exercise*, *48*(12), 2503-2511. DOI: 10.1249/MSS.0000000000001062

Dunstan, D. W., Howard, B., Healy, G. N., & Owen, N. (2012). Too much sitting – A health hazard. *Diabetes Research and Clinical Practice, 97*(3), 368-376. DOI: 10.1016/j.diabres.2012.05.020

Drury, C. G., Hsiao, Y. L., Joseph, C., Joshi, S., Lapp, J., & Pennathur, P. R. (2008). Posture and performance: sitting vs. standing for security screening. *Ergonomics, 51*(3), 290-307. DOI: https://doiorg.proxy1.lib.uwo.ca/10.1080/00140130701628790

A version of this chapter has been published: Smith, S., & Prapavessis, H. (2017). “Standing up” for students: effects on classroom performance. *International Journal of Ergonomics,* 7(1). DOI: http://www.cscjournals.org/manuscript/Journals/IJEG/Volume7/Issue1/IJEG-44.pdf

Ebara, T., Kubo, T., Inoue, T., Murasaki, G., Takeyama, H., Sato, H., … Itani, T. (2008). Effects of adjustable sit-stand VDT workstations on workers' musculoskeletal discomfort, alertness and performance. *Industrial Health, 46*(5), 497-505. DOI: https://doi.org/10.2486/indhealth.46.497

Funk, R. E., Taylor, M. L., Creekmur, C. C., Ohlinger, C. M., Cox, R. H., & Berg, W. P. (2012). Effect of walking speed on typing performance using an active workstation. *Perceptual and Motor Skills, 115*(1), 309-318. DOI: https://doiorg.proxy1.lib.uwo.ca/10.2466/06.23.26.PMS.115.4.309-318

Graves, L. E. F., Murphy, R. C., Shepherd, S. O., Cabot, J., & Hopkins, N. D. (2015). Evaluation of sit-stand workstations in an office setting: a randomized controlled trial. *Public Health,* 15(1), 1145. DOI: 10.1186/s12889-015-2469-8

Groeber, M. (2016). *How to calculate typing speed (WPM) and accuracy.* Retrieved from https://www.speedtypingonline.com/typing-equations

Healy, G., Dunstan, D., Salmon J. (2008). Breaks in sedentary time: beneficial associations with metabolic risk. *Diabetes Care,* 31(4), 661-666. DOI: 10.2337/dc07-2046

Husemann, B., Mach, C. V., Borsotto., Zepf, K., & Scharnbacher, J. (2009). Comparisons of musculoskeletal complaints and data entry between a sitting and a sit-stand workstation paradigm. *Human Factors, 5*(3), 310-320. DOI: 10.1177/0018720809338173

Karakolis, T., & Callaghan, J. P. (2014). The impact of sit-stand office workstations on worker discomfort and productivity: a review. *Applied Ergonomics,* 45(3), 799-806. DOI: 10.1016/j.apergo.2013.10.001

A version of this chapter has been published: Smith, S., & Prapavessis, H. (2017). "Standing up" for students: effects on classroom performance. *International Journal of Ergonomics,* 7(1). DOI: http://www.cscjournals.org/manuscript/Journals/IJEG/Volume7/Issue1/IJEG-44.pdf

Moulin, M. S. (2016). An assessment of sedentary time among undergraduate students at an urban Canadian university. *Electronic Thesis and Dissertation Repository, 3699.* DOI: https://ir.lib.uwo.ca/etd/3699/

Pronk, N. P., Katz, A. S., Lowry, M., Payfer, J. R. (2012). Reducing occupational sitting time and improving worker health: the take-a –stand project, 2011. *Preventing chronic disease, 9*, 154. DOI: 10.5888.pcd9.110323

Straker, L., Levine, J., & Campbell, A. (2009). The effects of walking and cycling computer workstations of keyboard and mouse performance. *Human Factors,* 51(6), 831-844. DOI: 10.1177/0018720810362079

Storrie, K., Ahern, K., & Tuckett, A. (2010). A systematic review: Students with mental health problems – a growing problem. *International Journal of Nursing Practice, 16*(1), 1-6. DOI: 10.1111/j.1440-172X.2009.01813.x

Tremblay, M. S., Colley, R. C., Saunders, T. J., Healy, G. N., & Owen, N. (2010). Physiological and health implications of a sedentary lifestyle. *Applied physiology, nutrition, and metabolism, 35*(6), 725-740. DOI: https://doi-org.proxy1.lib.uwo.ca/10.1139/H10-079

A version of this chapter has been published: Smith, S., & Prapavessis, H. (2017). “Standing up” for students: effects on classroom performance. *International Journal of Ergonomics,* 7(1). DOI: http://www.cscjournals.org/manuscript/Journals/IJEG/Volume7/Issue1/IJEG-44.pdf

CHAPTER 3: Standing and Dynamic Sitting: Effects on University Classroom Performance - A Pilot Study

Introduction

Sedentary behavior is any waking behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture (Sedentary Behaviour Research Network, 2012). Increased sedentary behavior, independent of moderate-to-vigorous physical activity (MVPA), is a risk factor for many health problems including but not limited to: diabetes, cardiovascular disease, cancer, and depression (Lee & Wong, 2015; Schmid & Leitzmann, 2014; Teychenne et al., 2010; Wilmot et al., 2012). Ekelund et al., (2016) found that individuals need to accumulate 60-75 minutes of daily MVPA to eliminate the risk of all-cause mortality, as long as daily sitting time does not exceed 8 hours per day. Unfortunately, the average Canadian adult is sedentary for approximately 9.5 hours of their waking day (Statistics Canada, 2013). These trends are not only apparent in Canada but are happening worldwide (Ng & Popkin, 2012).

Both behavioral and environmental interventions to reduce sedentary time have received a substantial amount of research attention over the past 10 years. Examples of behavioral components of interventions to reduce sedentary behavior include text-based messages (Bond et al., 2014; Cotten & Prapavessis, 2016), telephone calls (Healy et al., 2013), email reminders (Chau et al., 2016), and providing feedback to the amount of time spent sedentary and active (Hendriksen et al., 2016; Torbeynes et al., 2016). Examples of environmental changes are the use of a standing desk, dynamic sitting chair (i.e. sit in a more active way: chairs without back support, unstable chairs, exercise balls,

etc.), and other environmental workplace designs that promote less sedentary behavior (Gorman et al., 2013). Dynamic sitting chairs, such as the stability ball desk (Beers et al., 2008), sit-stand workstations (Graves et al., 2015), active treadmill workstations (Cao et al., 2016), cycling workstations (Torbeyns et al., 2016) and active elliptical workstations (Botter et al., 2016) have been shown to improve body composition (e.g., weight) (Torbeyns et al., 2016) and metabolic profiles (e.g., blood glucose levels) (Graves et al., 2015) as well as increase energy expenditure (Beers et al., 2008; Botter el al., 2016; Cao et al., 2016).

University students unfortunately spend more than 11 hours per day being sedentary (Cotten & Prapavessis, 2016; Prapavessis et al., 2015; Wong et al., 2016). One area where sedentary behavior can be reduced for university students is in the classroom. At present, students are forced to sit in a static position for all their lectures, every day, for their whole university degree. This accumulates to large sums of forced sedentary behavior. Standing and dynamic sitting postures are a way to reduce university classroom sedentary behavior. Active breaks during class could be used to aid in breaking up sedentary time during class (Drummy et al., 2016); however, environmental manipulations such as standing and dynamic sitting options are likely less disruptive and eliminate sedentary behavior during their entire use. Some university classes require students to be sedentary for 50 minutes before moving to a different classroom for their next lecture. Further, many students have multiple lectures that require them to stay in the same classroom. Although there are no specific adult guidelines for sedentary behavior at this time, 50 minutes of continuous sedentary behavior is much longer than the current beneficial break time of 2-4 minute every 20 minutes of sitting (Altenburg et

al., 2013; Healy et al., 2008; Healy et al., 2011). Additionally, research shows that sitting less than 3 hours per day could result in a 2-year gain in life expectancy (Katzmarzyk & Lee, 2012) and sitting less than 4 hours per day reduces all-cause mortality (van der Ploeg et al., 2012). Furthermore, studies have shown that those who led a sedentary lifestyle in university remain sedentary 10 years later (Keating et al., 2005).

A major concern with these alternative posture options is that performance will be reduced. However, recent research and reviews concluded that sit-stand and active workstations in office workers do not cause a decrease in performance (Karakolis & Callaghan, 2014; MacEwen et al., 2015; Neuhaus et al., 2014; Russell et al., 2016). Additionally, recent systematic reviews on the effects of standing desks within the primary/elementary school classroom found increased energy expenditure, reduced sedentary behavior, and no detrimental effect on classroom behavior and learning (Castellucci et al., 2017; Sherry et al., 2016). Researchers stress the importance of assessing these interventions with secondary/ high school and college/ university students, as reducing sedentary behavior is needed throughout the life course (Sherry et al., 2016).

In addition to being an extremely sedentary population, tasks university students have to perform specifically in the classroom (i.e., listen, record, and recall lecture material) are sufficiently different from those of office workers. Compared to primary and elementary school students, typical university classes are much larger, quicker paced, and in most cases learning is more self-directed for university students. In addition, classroom performance is likely held at a premium for university students;

hence, many may choose not to use standing and dynamic sitting postures if there is doubt that their performance will suffer. Experimental evidence is warranted to show that performance in the university classroom is not compromised by the introduction of standing and dynamic sitting postures to reduce sedentary behavior. Further, concerns about discomfort with the alternative postures must be addressed.

To our knowledge, only one published study has examined the effects of alternative postures on classroom performance of university students. In that study, Smith and Prapavessis (2017) had students (N = 40) perform three 3-minute classroom simulations including a typing and memory task under classic sitting, dynamic sitting, and standing posture conditions. Results showed no significant difference in the typing, memory, or perception between the classic sitting, dynamic sitting, and standing postures. A limitation with this work is that the classroom performance tasks were performed for only 3 minutes under each condition. Consequently, we can only speculate that the findings would hold over a longer typical university class time of 50 minutes. Further, it is unknown if over the 50 minute period students will experience any discomfort from the dynamic sitting or standing posture.

Hence, the purpose of this pilot study was to investigate the effect of classic sitting, dynamic sitting, and standing posture during a longer, ecologically valid class time of 50 minutes. Pilot studies are valuable in acquiring essential information about the methods and procedures (e.g. assessing processes such as recruitment, treatment, and follow-up as well as effect size estimates) before beginning a large adequately powered randomized control trial (Arain et al., 2010; Thabane et al., 2010). The main outcome was classroom performance. Secondary outcomes were cognitive performance

(attention, perceptual performance, executive memory performance, and working memory performance) and self-reported measures of discomfort, ease, enjoyment, focus, and likelihood of future use. The main hypothesis was that no significant difference would be found among the 3 postures with respect to classroom performance. Secondary hypotheses were that no significant differences would be found among the 3 postures for any of the cognitive performance and self-reported measures. In addition, we expected to show a negative correlation between the rating of discomfort and the likelihood of alternative use.

Methods

Participants

Participants were students from the University of Western Ontario and their demographic characteristics can be found in Table 1. Students older than 18 years of age and fluent in English were eligible to participate. Participants with musculoskeletal deficits were ineligible to participate. Participants were recruited by responding to advertisement forms. Eligible participants were enrolled into the study on a first come, first serve basis. Participants and researchers were not blinded. There were no dropouts and all participants complied with the intervention (i.e. used the assigned posture during the whole assessment). All participants were recruited and data were collected over a 1-month period. Participants provided informed written consent to participate in the intervention and were compensated $30 for 3 hours of their time (3 x 1 hour). The Western University Health Science Research Ethics Board approved the research intervention.

Table 1

Participant Demographics

Characteristics	Percent (%)	Mean	SD
Age (years)		21.85	2.81
BMI (kg/ m^2)		23.00	3.38
Gender			
Male	50%		
Female	50%		
Ethnicity			
Caucasian	55%		
Asian	20%		
Other	25%		
Faculty			
Health Science	35%		
Science	35%		
Engineering/ Business	30%		
Degree			
Undergraduate	65%		
Graduate	35%		

Note. BMI = Body Mass Index; kg = Kilogram; m = Meter; SD = Standard Deviation

Design, Intervention, and Outcome Measures

The intervention followed a within subject counterbalanced design. This design was chosen to reduce errors associated with individual differences and increase statistical power (Charness et al., 2012). Each participant used a classic sitting, dynamic sitting, and standing condition in a random order. The classic sitting condition is an adjustable computer chair, the dynamic sitting condition resembles a bosu ball on wheels that comes in three sizes (small, medium, and large), and the standing condition has an adjustable keyboard and computer monitor without a chair that can move to any height (Figure 1). The conditions were selected as both standing and dynamic sitting have more feasible and cost-effective potential to be implemented in a university classroom than other alternative workstations, such as sit-stand, treadmill, and cycling desks.

Figure 1. Classic sitting (bottom left), dynamic sitting (top left), and standing (right) conditions

Participants selected one of three dynamic sitting bosu balls (Figure 1, top-left) and adjusted the chairs (Figure 1, bottom-left) and keyboard height (Figure 1, right) to their own comfort. For each posture, the keyboard and computer monitor were the same (Figure 1, right). There was no acclimation period to any of the conditions or tasks. Each posture was maintained for 1 hour (i.e. participants were not permitted to change

postures during the task). Between each condition, participants were given a 10-minute break; a typical break time interval between 50-minute university classes.

Primary Outcome. During each hour, participants listened to 1 of 3 approximately 50 minute online lectures from a University of Western Ontario Professor (Appendix). The lectures were from the "Classes Without Quizzes" YouTube channel (Dozois, 2015 https://www.youtube.com/watch?v=kXanCUZSuGM&t=153s; Lannigan, 2011 https://www.youtube.com/watch?v=XVb44g4ECOw&t=2664s; Mottola, 2011 https://www.youtube.com/watch?v=Mp-AFJ0n0vY&t=546s). The order of the lectures was randomized. No participants had heard the lecture prior the intervention. While listening to the lecture, students were encouraged to take typed (N=14) or written (N=4) notes as if they were in class. Some participants (N=2) expressed that they typically did not take notes during class, thus they were permitted to solely listen to the lecture. Participants were not assessed on their notes and were not permitted to use their notes during the quiz. Following the lecture, participants were given a 5-minute quiz on the lecture consisting of 5 multiple choice (MC) and 5 fill in the blank (FB) questions (Appendix). Classroom performance, the primary outcome, was assessed by correct response to post lecture questions (Appendix).

Secondary Outcomes. At baseline and following each of the lectures and associated quizzes, secondary outcomes were obtained. Specifically, the speed and accuracy of 4 online cognitive tasks were used to assess attention ("Go/No-go task"; Nosek & Banaji, 2001), perceptual performance ("Fast Counting task"; Simon et al., 1993), executive memory performance ("Eriksen Flanker test"; Eriksen & Eriksen, 1974), and working memory performance ("N-back" with N = 2; Kirchner, 1958). These

same cognitive tests have been used in research on alternative workstations in office workers (Commissaris et al., 2014).

Further secondary outcomes were obtained through self-reported measures. A questionnaire was given following each condition to assess discomfort, ease, enjoyment, and focus of participants. All questions used a Likert Scale. The discomfort scale was anchored at 0 by the descriptor "no discomfort" and at 5 by the descriptor "very severe discomfort". The ease scale was anchored at 1 by the descriptor "very difficult" and at 5 by the descriptor "very easy". The enjoyment scale was anchored at 1 by the descriptor "very unenjoyable" and at 5 by the descriptor "very enjoyable". The focus scale was anchored at 1 by the descriptor "very unfocused" and at 5 by the descriptor "very focused". Additionally, a final questionnaire was given at the end of the study to assess the likelihood of students using an alternative posture, given that it was available, in class. This final questionnaire was anchored at 1 by the descriptor "very unlikely" and at 5 by the descriptor "very likely". Similar Likert scales have been used in within the sedentary behavior literature to assess these types of self-reported perceptions in office workers (Labonte-LeMoyne et al, 2015; Straker et al, 2009).

Statistics

Statistics were completed using SPSS (Statistical Package for the Social Science) software 2016 version 24. To check the fidelity of the manipulation, one-way repeated measures ANOVA were used to examine for classroom performance differences between the three quizzes. For the main results, one-way repeated measures ANOVA were used to examine for classroom performance, cognitive performance, and self-reported perception differences across classic sitting, dynamic sitting, and standing

conditions. In addition, one-way repeated measures ANOVA were also used to examine any time (order) effect. Pearson R was used to compute the correlation between discomfort rating and likelihood of use.

When appropriate, a Post Hoc Tukey test was conducted. All ANOVAs were accompanied by partial eta square values (η^2_p) to show effect sizes and the level of significance was set at .05. For all statistics tests, any extreme outliers were removed (*Q1-3*IQR* or *Q1+3*IQR*). There was no other missing data in the statistical analysis. One extreme outlier was removed for the one-way repeated measures ANOVA by lecture manipulation check. In total, four extreme outliers were removed for the one-way repeated measures ANOVA examining classroom performance (0), cognitive performance (3), and self-reported perception differences (1) by posture (Table 2). In sum, nine extreme outliers were removed for the one-way repeated measures ANOVA examining classroom performance (1), cognitive performance (8), and self-reported perception differences (0) by time (Table 3).

Results

Manipulation (Fidelity) Check

Manipulation checks confirmed that there was no significant classroom performance differences between the 3 lectures ($F(2,56)=1.85$, $p=.17$, $\eta^2_p=.06$).

Primary Outcome

Classroom performance. Descriptive data can be found in Table 2 and Table 3. There was no significant difference in the classroom performance between the classic sitting, dynamic sitting, and standing conditions ($F(2,57)=.23$, $p=.80$, $\eta^2_p=.08$). There

was no significant decline/improvement in classroom performance over time from the first, second, and third lecture ($F(2,56)=1.89$, $p=.16$, $\eta^2_p=.06$).

Secondary Outcomes

Cognitive performance. Descriptive data can be found in Table 2 and Table 3.

For the Go/No-Go task, there was no significant difference in the speed ($F(2,57)=.04$, $p=.96$, $\eta^2_p=.01$) between the classic sitting, dynamic sitting, and standing conditions. There was a significant difference in the accuracy ($F(2,54)=3.93$, $p=.03$, $\eta^2_p=.13$) between the classic sitting, dynamic sitting, and standing conditions. A post hoc analysis [Tukey] demonstrated a significant difference between the classic sitting and standing postures ($p=.02$), where participants performed more accurately while in the standing posture. There was no significant difference between the classic sitting and dynamic sitting ($p=.40$) or dynamic sitting and standing ($p=.27$) postures. There was no significant difference in speed ($F(2, 57)=.27$, $p=.76$, $\eta^2_p=.01$) or accuracy ($F(2, 54)=2.89$, $p=.06$, $\eta^2_p=.10$) over time from the first, second, and third hour.

For the Fast Counting task, there was no significant difference in the speed ($F(2,57)=.08$, $p=.93$, $\eta^2_p=.03$) or accuracy ($F(2,57)=.16$, $p=.85$, $\eta^2_p=.06$) between the classic sitting, dynamic sitting, and standing conditions. There was a significant difference in speed ($F(2, 57)=3.79$, $p=.03$, $\eta^2_p=.12$) and accuracy ($F(2, 57)=3.74$, $p=.03$, $\eta^2_p=.12$) over time from the first, second, and third hour. A post hoc analysis [Tukey] demonstrated a significant difference between the first and third hour for speed ($p=.03$) and accuracy ($p=.04$), where participants performed faster and more accurately in the third hour. There was no significant difference in speed and accuracy respectively

between the first and second hour (p=.16 and p=.08) and second and third hour (p=.70 and p=.94).

For the Eriksen Flanker task, there was no significant difference in the speed (F(2,57)=.15, p=.86, η^2_p =.05) or accuracy (F(2,57)=.27, p=.76, η^2_p =.09) between the classic sitting, dynamic sitting, and standing conditions. There was no significant difference in speed (F(2, 57)=.90, p=.41, η^2_p =.03) over time from the first, second, and third hour. There was a significant difference in accuracy (F(2, 53)=8.57, p<.01, η^2_p =.24) over time from the first, second, and third hour. A post hoc analysis [Tukey] demonstrated a significant difference between the first and third hour (p<.01), where participants performed less accurately in the third hour. There was no significant difference between the first and second hour (p=.08) and second and third hour (p=.11).

For the N-Back task, there was no significant difference in the speed (F(2,57)=.38, p=.69, η^2_p =.13) or accuracy (F(2,57)=.12, p=.89, η^2_p =.04) between the classic sitting, dynamic sitting, and standing conditions. There was no significant difference in speed (F(2, 57)=2.12, p=.13, η^2_p =.07) or accuracy (F(2, 56)=2.21, p=.12, η^2_p =.07) over time from the first, second, and third hour.

Self-reported measures. Descriptive data can be found in Table 2 and Table 3.

For self-reported discomfort, there was a significant difference between the classic sitting, dynamic sitting, and standing conditions (F(2,57)= 4.13, p=.02, η^2_p =.13). A post hoc analysis [Tukey] demonstrated a significant difference between the classic sitting and standing postures (p=.02), where participants rated the standing posture to cause more discomfort. There was no significant difference between the classic sitting and dynamic sitting (p=.73) or dynamic sitting and standing (p=.12) postures. There was

no significant difference in the discomfort rating over time from the first, second, and third hour ($F(2, 57)= .26$, $p=.77$, $\eta^2_p =.01$).

For self-reported ease, there was a significant difference between the classic sitting, dynamic sitting, and standing conditions ($F(2,56)= 7.50$, $p<.01$, $\eta^2_p =.21$). A post hoc analysis [Tukey] demonstrated a significant difference between the classic sitting and standing posture ($p<.01$), where participants rated the standing posture to be more difficult. There was no significant difference between the classic sitting and dynamic sitting ($p=.12$) or dynamic sitting and standing ($p=.15$) postures. There was no significant difference in the ease rating over time from the first, second, and third hour ($F(2, 57)=.65$, $p=.53$, $\eta^2_p =.02$).

For self-reported enjoyment, there was no significant difference between the classic sitting, dynamic sitting, and standing conditions ($F(2,57)= 1.01$, $p=.37$, $\eta^2_p =.03$). There was no significant difference in enjoyment over time from the first, second, and third hour ($F(2, 57)=.04$, $p=.96$, $\eta^2_p <.01$).

For self-reported focus, there was no significant difference between the classic sitting, dynamic sitting, and standing conditions ($F(2,57)= .95$, $p=.39$, $\eta^2_p =.03$). There was no significant difference in the focus rating over time from the first, second, and third hour ($F(2, 57)=2.96$, $p=.06$, $\eta^2_p =.09$).

Students rated that they were significantly more likely to use a dynamic sitting posture in class than a standing posture ($F(1,38)= 6.65$, $p=.01$, $\eta^2_p =.15$).

There was a significant relationship between discomfort and likelihood of use ($R=-.65$ $p<.01$). This correlation was negative, such that if discomfort is increased for a posture, the likelihood of use is decreased for that posture, and vice versa.

Table 2

Classroom performance, cognitive performance, and self-reported measures with classic sitting, dynamic sitting, and standing

Outcome	Classic Sitting	Dynamic Sitting	Standing
Classroom Performance[a]	69 (16)	71 (14)	72 (15)
Cognitive Performance[b]			
Go/No-Go	420 (60)/ 96 (5)	415 (70)/ 98 (4)	421 (81)/ 100 (0)
Fast Counting	997 (165)/ 71 (18)	1007 (159)/ 72 (17)	1018 (184)/ 74 (17)
Eriksen Flanker	473 (52)/ 98 (3)	482 (61)/ 98 (3)	477 (45)/ 98 (3)
N-Back	677 (243)/ 83 (20)	710 (190)/ 79 (21)	653 (203)/ 81 (22)
Self-Reported Measures[c]			
Discomfort	0.75 (1.07)	1.05 (1.28)	1.85 (1.39)
Ease	4.74 (0.56)	4.15 (0.93)	3.60 (1.14)
Enjoyment	3.75 (1.07)	3.50 (1.32)	3.20 (1.28)
Focus	3.65 (1.09)	3.50 (0.89)	3.20 (1.15)
Future Use		3.90 (1.21)	2.75 (1.59)

Note. Mean (Standard Deviation); Speed/ Accuracy
[a]Classroom performance = number of questions correct (percent)
[b]Cognitive performance = speed (millisecond) and accuracy (percent)
[c]Self-reported measures = rating on 5 point Likert Scale

Table 3

Classroom performance, cognitive performance, and self-reported measures with the 1st, 2nd, and 3rd hour

Outcome	1st Hour	2nd Hour	3rd Hour
Classroom Performance[a]	76 (14)	71 (14)	67 (12)
Cognitive Performance[b]			
Go/No-Go	425 (85)/ 97 (5)	422 (57)/ 100 (0)	409 (66)/ 97 (5)
Fast Counting	1084 (167)/ 64 (18)	989 (143)/ 75 (14)	949 (166)/ 77 (17)
Eriksen Flanker	490 (43)/ 100 (0)	468 (53)/ 98 (3)	475 (60)/ 96 (3)
N-Back	753 (222)/ 75 (26)	662 (212)/ 86 (12)	624 (175)/ 86 (15)
Self-Reported Measures[c]			
Discomfort	1.25 (1.25)	1.35 (1.23)	1.05 (1.50)
Ease	4.25 (1.02)	3.90 (1.17)	4.20 (0.95)
Enjoyment	3.55 (1.23)	3.45 (1.36)	3.45 (1.15)
Focus	3.90 (0.97)	3.25 (1.02)	3.20 (1.06)

Note. Mean (Standard Deviation); Speed/ Accuracy
[a]Classroom performance = number of questions correct (percent)
[b]Cognitive performance = speed (millisecond) and accuracy (percent)
[c]Self-reported measures = rating on 5 point Likert Scale

Discussion

As hypothesized, classroom performance did not suffer by changing students' anatomical position from classic sitting. These findings are in line with the classroom performance findings reported by Smith and Prapavessis (2017) and the office worker findings reported by Karakolis & Callaghan (2014). Further, as expected and as previously demonstrated in office workers (Commissaris et al., 2014) there was no significant difference in the Fast Counting, Eriksen Flanker, and N-back cognitive tasks between the classic sitting, dynamic sitting, and standing conditions. Taken together, our findings demonstrate no perceptual performance, executive memory, and working memory performance differences among the conditions. However, participants performed the Go/No-Go test more accurately while using the standing posture. This indicates that the standing posture may cause increased attention over the classic sitting posture. This differs from previous office worker research (Commissaris et al., 2014) and should be investigated further before clear conclusions can be made.

As hypothesized, the dynamic sitting posture did not differ from the classic sitting posture in terms of self-reported discomfort, ease, enjoyment, and focus. This is in agreement with previous research in office workers that found dynamic sitting to be well liked and comfortable (Beers et al., 2008). As also hypothesized, the standing posture did not differ from the classic sitting posture in terms of self-reported enjoyment and focus. This is in agreement with previous work where students rated standing

posture equal to classic sitting posture in terms of enjoyment (Smith & Prapavessis, 2017). However, it is interesting that participants reported using the standing posture as significantly more difficult than using the classic sitting posture, yet classroom and cognitive performance did not suffer. This self-report difference may be due to the unfamiliarity of standing during a lecture rather than a true increase in difficulty in standing. Future work should aim to acclimatize participants to the alternative postures and tasks.

A slight increase in discomfort was observed with the standing posture. This is in agreement with previous research where office workers rated the dynamic sitting posture more comfortable than the standing posture (Beers et al., 2008). However, the difference was small and average discomfort was still below mild discomfort on the scale used. Additionally, some individuals experience no discomfort with the standing posture. Thus, students should be at least given the opportunity to make a choice to reduce their sedentary time in class with alternative postures. Since students are accustomed to be seated for all their lectures, they may simply be unfamiliar with standing for a longer period of time, thus resulting in a slight discomfort. Additionally, due to the relatively short one time exposure to each experimental condition, it is possible that discomfort from standing may decrease or increase with repeated exposures. Perhaps with incremental increased use of the standing posture, any discomfort will disappear through adaptation. Alternatively increased standing exposure may exacerbate discomfort. Future research should aim to examine this issue further. Further, participants were not asked how much they typically stand during the day prior to the intervention. Perhaps individuals that stand more experienced less discomfort than those who stand less.

Additionally, participants were not asked why they experienced discomfort. For some individuals the discomfort may have been due to a pre-existing condition rather than the posture itself. Whatever the cause, discomfort must be minimized in order for most individuals to regularly use the standing posture.

The increase in discomfort from classic sitting to standing, but no change in discomfort from dynamic sitting to either posture may be the primary reason why students would prefer to use a dynamic sitting over a standing posture, if they were available in class. This is in agreement with previous research where office workers preferred using the dynamic sitting posture compared to the standing posture (Beers et al, 2008). We found a significant negative correlation between discomfort and likelihood of use, in that if discomfort is increased for a condition, the likelihood of use is decreased for that condition.

There was no significant decline/improvement in classroom performance, Go/No-Go speed and accuracy, Eriksen Flanker speed, N-back speed and accuracy, discomfort, ease, enjoyment, and focus rating over time from the first, second, and third lecture. This demonstrates that students are able to perform just as well following 1 hour of class as following 2 or 3 hours of class. There was a significant improvement in Fast Counting speed and accuracy from the first hour to the third hour. This is attributed to a learning effect with the Fast Counting task. However, any time (order) effects are counteracted by the randomized counterbalanced design. There was also a significant decline in Eriksen Flanker accuracy from the first hour to the third hour (Table 3). This may be due to slight distraction or fatigue for this task. However, similarly any time (order) effects for this test are also counteracted by the randomized counterbalanced

design.

We acknowledge that there are many financial and structural challenges (i.e. visibility and access issues) for implementing alternative workstations in the university classrooms. However, in support of implementation, a recent study by Benzo et al. (2016) examined the acceptability of introducing standing desks in college classrooms. The large majority of students (95%) reported they would prefer the option to stand in class. Most students (76.6%) and instructors (86.6%) reported being in favor of introducing standing desks into college classrooms. Their findings support the acceptability of introducing standing desks in college classrooms. Additionally, dynamic sitting chairs would not impact visibility and would cause less access issues than standing desk options would. Future work should investigate the acceptability of introducing dynamic sitting chairs in university classrooms.

Taken together with the current findings that classroom performance, cognitive performance, enjoyment, and focus do not suffer by changing students' anatomical position from classic sitting; universities should consider providing dynamic sitting and standing options in university classrooms to allow their university students to obtain health benefits as they learn. Further, by implementing these alternative workstations, it will allow a university to be a distinguished world leader in promoting the reduction of sedentary time and bettering student physical and mental health.

There are a number of strengths with the present study. First, the within subject counterbalanced design allowed for high internal validity. Second, the intervention had strong external validity in that the classroom performance tasks were exactly what students usually do in a real university lecture (i.e., listen to, record, and recall lecture

material). Third, the participants were all university students from a wide range of disciplines. Fourth, the cognitive performance tests selected are widely accepted in this field and have been used in previous research. Finally, the study targets an important population, university students, who spend a substantial amount of sedentary time in class and while studying. Interventions are therefore needed to assist students in reducing their sedentary behavior without impacting their classroom and study performance.

Despite these strengths, there are several weaknesses that must be acknowledged. First, some university classes are 2 or 3 hours long. Hence, we can only speculate that our findings would hold over these longer class times. However, in the present study students were able to perform just as well following 1 hour of class as following 2 and 3 hours of class. Thus, it is expected that our finding would hold over these longer class times. Furthermore, we cannot infer that our finding would hold over multiple exposures to each experimental condition. Second, no pre intervention sedentary behavior was asked from participants. Thus, participants may vary in their pre-intervention standing, which may have influenced the results. Third, a simulated classroom lecture and quiz was used as opposed to an actual classroom lecture and quiz. This simulated classroom performance measure needs to be validated with actual performance measures in future work. However, at this time there are no standing or dynamic sitting options in university classrooms at the University of Western Ontario for research to be conducted. Fourth, the standing posture findings reported may not necessarily apply to standing desks and/or sit-stand desks. This issue warrants further research attention. Lastly, this was the first study to address this issue in an ecological manner with university students

who volunteered and were compensated. This work must be replicated with a larger sample using different research designs (i.e., randomized control trial) before findings can be universally accepted.

Conclusion

Classroom performance, cognitive performance, enjoyment, and focus do not suffer by changing students' anatomical position from classic sitting. However, standing posture may cause more discomfort and difficulty for some students. Ways to decrease and eliminate discomfort and difficulty should be further investigated before all students have access to standing options in class. Discomfort differences do not exist between dynamic sitting and classic sitting and dynamic sitting postures are more likely to be used in class than standing postures. Hence, at this early stage of inquiry there is no evidence to recommend against providing dynamic sitting and standing options in university classrooms to allow students to receive health benefits as they learn.

References

Altenburg, T. M., Rotteveel, J., Dunstan, D. W., Salmon, J., & Chinapaw, M. J. (2013). The effect of interrupting prolonged sitting time with short, hourly, moderate-intensity cycling bouts on cardiometabolic risk factors in healthy, young adults. *Journal of Applied Physiology*, 115(12), 1751-1756. DOI: 10.1152/japplphysiol.00662.2013

Arain, M., Campbell, M. J., Cooper, C. L., & Lancaster, G. A. (2010). What is a pilot or feasibility study? A review of current practice and editorial policy. *BMC Medical Research Methodology, 10*(1), 67. DOI: 10.1186/1471-2288-10-67

Beers, E. A., Roemmich, J. N., Epstein, L. H., & Horvath, P. J. (2008). Increasing passive energy expenditure during clerical work. *European Journal of Applied Physiology*, 103(3), 353-360. DOI: 10.1007/s00421-008-0713-y.

Benzo, R. M., Gremaud, A. L., Jerome, M., & Carr, L. J. (2016). Learning to stand: the acceptability and feasibility of introducing standing desks into college classrooms. *International Journal of Environmental Research and Public Health*, 13, 823. DOI: 10.3390/ijerph13080823

Bond, D. S., Thomas, J. T., Raynor, H. A., Moon, J., Sieling, J., Trautvetter, J., … Wing, R.R. (2014). B-MOBILE – a smartphone-based intervention to reduce sedentary time in overweight/ obese individuals: a within-subjects experimental trial. *Plos One*, 9(6), 100821. DOI: 10.1371/journal.pone.0100821

Botter, J., Ellegast, R. P., Burford, E. M., Weber, B., Konemann, R., & Commissaris, D. A. C. M. (2016). Comparison of the postural and physiological effects of two

dynamic workstations to conventional sitting and standing workstations. *Ergonomics*, 59(3), 449-463. DOI: 10.1080/00140139.2015.1080861

Cao, C., Liu, Y., Zhu, W., Ma, J. (2016). Effect of active workstation on energy expenditure and job performance: a systematic review and meta-analysis. *Journal of Physical Activity and Health*, 13(5), 562-571. DOI: 10.1016/j.apergo.2014.05.003

Castellucci, H. A., Arezes, P. M., Molenbroek, J. F. M., de Bruin, R., & Viviani, C. (2017). The influence of school furniture on students' performance and physical responses: results of a systematic review. *Ergonomics*, 60(1), 93-110. DOI: 10.1080/00140139.2016.1170889

Charness, G., Gneezy, U., & Kuhn, M. A. (2012). Experimental methods: between-subject and within-subject design. *Journal of Economics Behavior & Organization, 81*(1), 1-8. DOI: 10.1016/j.jebo.2011.08.009

Chau, J. Y., Sukala, W., Fedel, F., Do, A., Engelen, L., Kingham, M., Sainsbury, A., & Bauman, A. E. (2016). More standing and just as productive: Effects of a sit-stand desk intervention on call center workers sitting, standing, and productivity at work in the opt to stand pilot study. *Preventative Medicine Reports*, 3(1), 68-74. DOI: 10.1016/j.pmedr.2015.12.003

Commissaris, D. A. C. M., Konemann, R., Mastrigt, S. H., Burford, E. M., Botter, J. Douwes, M., & Ellegast, R. P. (2014). Effects of a standing and three dynamic workstations on computer task performance and cognitive function tests. *Applied Ergonomics*, 45(6), 1570-1578. DOI: 10.1016/j.apergo.2014.05.003

Cotten, E., & Prapavessis, H. (2016). Increasing nonsedentary behaviors in university students using text messages: randomized controlled trial. *JMIR MHealth and UHealth*, 4(3), 99. DOI: 10.2196/mhealth.5411

Dozois, D. (2015). *Strategies for overcoming depression.* Retrieved from https://www.youtube.com/watch?v=kXanCUZSuGM&t=153s

Drummy, M., Murtagh, E. M., McKee, D. P., Breslin, G., Davison, G. W., & Murphy, M. H. (2016). The effect of a classroom activity break on physical activity levels and adiposity in primary school children. *Journal of Paediatrics and Child Health*, 52(7), 745-749. DOI: 10.1111/jpc.13182

Eriksen, B. A., & Eriksen, E. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perceptual Psychophysics*, 16(1), 143-149. DOI: 10.3758/BF03203267

Ekelund, U., Steene-Johannessen, J., Brown, W. J., Fagerland, M. W., Owen, N., Powell, K. E., … Lee, I. M. (2016). Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonized meta-analysis of data from more than 1 million men and women. *Lancet*, 388, 1302-1310. DOI: http://dx.doi.org/10.1016/ S0140-6736(16)30370-1

Graves, L. E. F., Murphy, R. C., Shepherd, S. O., Cabot, J., & Hopkins, N. D. (2015). Evaluation of sit-stand workstations in an office setting: a randomized controlled trial. *Public Health,* 15(1), 1145. DOI: 10.1186/s12889-015-2469-8

Gorman, E., Ashe, M. C., Dunstan, D. W., Hanson, H. M., Madden, K., Winkler, E. A. H., … Healy, G.N. (2013). Does an activity-permissive workplace change office

workers sitting and activity time?. *Plos One,* 8(10), 76723. DOI: 10.1371/journal.pone.0076723

Healy, G., Dunstan, D., Salmon J. (2008). Breaks in sedentary time: beneficial associations with metabolic risk. *Diabetes Care,* 31(4), 661-666. DOI: 10.2337/dc07-2046

Healy, G. N., Eakin, E. G., Lamontagne, A. D., Owen, N. Winkler, E. A. H., Wiesner, G., … Dunstan, D. W. (2013). Reducing sitting time in office workers: short-term efficacy of a multicomponent intervention. *Preventative Medicine,* 57(1), 43-48. DOI: 10.1016/j.ypmed.2013.04.004

Healy, G. N., Matthews, C. E., Dunstan, D. W., Winkler, E. A., & Owen, N. (2011). Sedentary time and cardio-metabolic biomarkers in US adults: NHANES. *European Heart Journal,* 32(5), 590-597. DOI: 10.1093/eurhearti/ehq451

Hendriksen, I. J. M., Bernaards, C. M., Steijn, W. M. P., & Hildebrandt, V. H. (2016). Longitudinal relationship between sitting time on a working day and vitality, work performance, presenteeism, and sickness absence. *Journal of Occupational and Environmental Medicine,* 58(8), 784-789. DOI: 10.1097/JOM.0000000000000809

Karakolis, T., & Callaghan, J. P. (2014). The impact of sit-stand office workstations on worker discomfort and productivity: a review. *Applied Ergonomics,* 45(3), 799-806. DOI: 10.1016/j.apergo.2013.10.001

Katzmarzyk, P. & Lee, I. (2012). Sedentary behavior and life expectancy in the US: a cause- deleted life table analysis. *BMJ Open,* 2, e000828. DOI: 10.1136/bmjopen-2012-000828

Keating, X. D., Guan, J., Pinero, J. C., & Bridges, D. M. (2005). A meta-analysis of college students' physical activity behaviors. *Journal of American College Health,* 54(2), 116-125. DOI: 10.3200/JACH.54.2.116-126

Kirchner, W. K., (1958). Age differences in short-term retention of rapidly changing information. *Journal Experimental Psychology,* 55(4), 352-358. DOI: http://dx.doi.org/10.1037/h0043688

Labonte-LeMoyne, E., Santhanam, R., Leger, P. M., Courtemanche, F., Fredette, M., & Senecal, S. (2015). The delayed effect of treadmill desk usage on recall and attention. *Computers in Human Behavior,* 46(1), 1-5. DOI: https://doi.org/10.1016/j.chb.2014.12.054

Lannigan, R. (2011). *Eat, drink, and be wary.* Retrieved from https://www.youtube.com/watch?v=XVb44g4ECOw&t=2664s

Lee, P. H., & Wong, K. Y. (2015). The association between time spend in sedentary behaviors and blood pressure: a systematic review and meta-analysis. *Sports Medicine,* 45(6), 867- 880. DOI: 10.1007/s40279-015-0322-y

MacEwen, B. T., MacDonald, D. J., & Burr, J. F. (2015). A systematic review of standing and treadmill desks in the workplace. *Preventative Medicine, 70, 50-58.* DOI: https://doi.org/10.1016/j.ypmed.2014.11.011

Mottola, M. (2011). *Exercise during pregnancy: what are the guidelines.* Retrieved from https://www.youtube.com/watch?v=Mp-AFJ0n0vY&t=546s

Neuhaus, M., Healy, G. N., Dunstan, D. W., Owen, N., & Eakin, E. G. (2014). Workplace sitting and height adjustable workstations a randomized controlled trial. *American Journal of Preventative Medicine,* 46(1), 30-40. DOI:

10.1016/j.amerpre.2013.09.009

Ng, S. W., & Popkin, B. M. (2012). Time use and physical activity: a shift away from movement across the globe. *Obesity Review,* 13, 659-680. DOI: 10.1111/j.1467-789X.2011.00982.x

Nosek, B. A., & Banaji, M. R. (2001). The go/no-go association task. *Social Cognition,* 19(6), 625-664. DOI: 10.1521/soco.19.6.625.20886

Prapavessis, H., Gaston, A., & DeJesus, S. (2015). The Theory of planned behavior as a model for understanding sedentary behavior. *Psychology of Sport and Exercise,* 19, 23-32. DOI: https://doi.org/10.1016/j.psychsport.2015.02.001

Russell, B. A., Summers, M. J., Tranent, P. J., Palmer, M. A., Cooley, P. D., & Pedersen, S. J. (2016). A randomized control trial of the cognitive effect of working in a seated as opposed to standing position in office workers. *Ergonomics,* 59(6), 737-744. DOI: http://dx.doi.org/10.1080/00140139.2015.1094579

Schmid, D., & Leitzmann, M. F. (2014). Television viewing and time spent sedentary in relation to cancer risk: a meta-analysis. *Journal of the National Cancer Institute,* 106(7). DOI: 10.1093/jnci/dju098

Sedentary Behaviour Research Network. (2012). *Statement on the Standardized Use of the terms "sedentary" and "sedentary behaviours."* Retrieved from www.sedentarybehaviour.org

Sherry, A. P., Pearson, N., & Clemes, S. A. (2016). The effects of standing desks within the school classroom: a systematic review. *Preventive Medicine Reports,* 3, 338-347. DOI: https://doi.org/10.1016/j.pmedr.2016.03.016

Simon, T., Cabrera, A., Kliegl, R. (1993). A new approach to the study of subizing as distinct enumeration, 929-934.

Smith, S., & Prapavessis, H. 2017. “Standing up” for students: effects on classroom performance. *International Journal of Ergonomics,* 7(1). DOI: http://www.cscjournals.org/manuscript/Journals/IJEG/Volume7/Issue1/IJEG44.pdf

Statistics Canada. (2013). *Directly measured physical activity of adults, 2012 and 2013.* Retrieved from http://www.statcan.gc.ca/pub/82-625-x/2015001/article/14135-eng.htm

Straker, L., Levine, J., & Campbell, A. (2009). The effects of walking and cycling computer workstations of keyboard and mouse performance. *Human Factors,* 51(6), 831-844. DOI: 10.1177/0018720810362079

Teychenne, M., Ball, K., & Salmon, J. (2010). Sedentary behavior and depression among adults: a review. *International Journal of Behavior Medicine,* 17(4), 246-254. DOI: 10.1007/s12529-010-9075-z

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., … Goldsmith, C. H. (2010). A tutorial on pilot studies: the what, why and how. *BMC Medical Research Methodology, 10*(1), 1. DOI: 10.1186/1471-2288-10-1

Torbeyns, T., de Geus, B., Stephen, B., de Pauw, K., Decroix, L., Van Cutsem, J., & Meeusen, R. (2016). Bike desks in the office: physical health, cognitive function, work engagement, and work performance. *Journal of Occupational and Environmental Medicine,* 58(12), 1257-1263. DOI: 10.1097/JOM.0000000000000911

van der Ploeg, H. P., Chev, T., Korda, R. J., Banks, E., & Bauman, A. (2012). Sitting time and all-cause mortality risk in 222497 Australian adults. *Archives of Internal Medicine*, 172(6), 494-500. DOI: 10.1016/j.ypmed.2014.10.004

Wilmot, E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Gray, L. J., Khunti, … Biddle, S. J. H. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review. *Diabetologia*, 55(11), 2895-2905. DOI: 10.1007/s00125-012-2677-z

Wong, T. S., Gaston, A., DeJesus, S., & Prapavessis, H. (2016). The utility of a protection motivation theory framework for understanding sedentary behavior. *Health psychology and behavioral medicine*, 4(1), 29-48. DOI: http://dx.doi.org/10.1080/21642850.2015.1128333

CHAPTER 4: Standing and Dynamic Sitting in the University Classroom: Perceptions of Students and Faculty

Introduction

Sedentary behavior is characterized by any waking behavior with an energy expenditure ≤ 1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture (Sedentary Behaviour Research Network, 2012). Increased sedentary behavior, independent of moderate-to-vigorous physical activity, is a risk factor for many health problems including but not limited to: diabetes, cardiovascular disease, cancer, and depression (Wilmot et al., 2012; Lee et al., 2015; Schmid et al., 2014; Teychenne et al., 2010). Unfortunately, university students spend more than 11 hours per day being sedentary (Cotten & Prapavessis, 2016; Wong et al, 2016; Prapavessis et al, 2015). For university students, a possible area where sedentary behavior can be reduced is in the classroom. At present, students are forced to sit for all their lectures for their entire university education, accumulating to large sums of sedentary behavior. Standing and dynamic sitting appear to be a way to reduce university classroom sedentary behavior and potentially improve health without negatively impacting classroom performance (Graves et al., 2015; Smith & Prapavessis, 2017).

Although alternative workstations have health benefits and do not appear to impact classroom performance questions still remain on their acceptability. To our knowledge, only 1 published study has examined the acceptability of introducing standing desks in college classrooms (Benzo et al., 2016). The majority of students (95%) reported they would prefer the option to stand in class, and most students (76.6%), as well as, instructors (86.6%) reported being in favor of introducing standing

desks into college classrooms. Although the work by Benzo et al (2016) provides preliminary supports the acceptability of introducing standing desks in college classrooms, it is not without limitations. These researchers, for instance, did not include other options such as dynamic sitting chairs that would not impact visibility or cause access issues. Further, they did not differentiate between standing only and sit-stand workstations or ask students and faculty the same questions on their perceptions of these alternative workstations. Additionally, no qualitative measures were included, that would provide an in-depth look at the barriers, facilitators, and perceptions of alternative workstation use.

Using a mixed-method approach, one purpose of this study was to quantitatively determine the perceptions of university students and faculty in using alternative workstations (standing, sit-stand, and dynamic sitting) in the classroom. Another purpose was to qualitatively examine the barriers, facilitators, and other issues of using alternative workstations in the university classroom.

Methods

Participants

University students. Participants (N=1005) were students from the University of Western, Ontario and their demographic characteristics can be found in Table 1. Students older than 18 years of age and fluent in English were eligible to participate. Participants were recruited by responding to advertisement forms. All participants were recruited and data were collected from September 18th to November 7th 2017. Participants provided implied informed consent to participate in the survey and were given the option to provide their email address to be entered into a draw to win $200.

The Western University Health Science Research Ethics Board approved this research intervention.

Table 1

University Student Participant Demographics (N=1005)

Characteristics	N	Percent	Mean	SD
Age (years)	1004		20.76	2.72
BMI (kg/ m^2)	998		23.41	4.80
Sedentary Behavior (h/d)	706		13.33	4.10
Physical Activity	839			
Active		30.39%		
Moderate		42.79%		
Inactive		26.82%		
Gender	1002			
Male		26.95%		
Female		72.75%		
Other		0.30%		
Ethnicity	1000			
Caucasian		59.40%		
Asian		22.00%		
Other		18.60%		
Faculty	1002			
Faculty of Arts and Humanities		4.99%		
Richard Ivey School of Business		2.00%		
Certificates and Diplomas		0.40%		
Faculty of Education		1.10%		
Faculty of Engineering		6.29%		
Graduate and Postdoctoral Studies		0.80%		
Faculty of Health Science		22.75%		
Faculty of Information and Media Studies		3.19%		
Interdisciplinary Studies		2.99%		
Faculty of Law		0.90%		
Schulich School of Medicine and Dentistry		4.49%		
Don Wright Faculty of Music		2.79%		
Faculty of Science		23.85%		
Faculty of Social Science		22.55%		
Other		0.90%		
Degree	1003			
Undergraduate		85.74%		
Graduate (Masters)		9.77%		
Graduate (Doctoral)		3.19%		
Graduate (Post Doctoral)		0.20%		
Other		1.10%		

Amount	1003	
Full Time		96.51%
Part Time		2.89%
Other		0.60%

Note. BMI = Body Mass Index; h/d = Hours per day; kg = Kilogram; m = Meter; N = Number of participants; SD = Standard Deviation
* Individual sedentary behavior > 24 h/d were not included in calculating mean or SD

University faculty. Participants (N=218) were faculty members from the University of Western, Ontario and their demographic characteristics can be found in Table 2. Participants were recruited by responding to an email. All participants were recruited and data were collected from September 18th to November 23rd 2017. Participants provided implied informed consent to participate in the survey and were not compensated for their participation. The Western University Health Science Research Ethics Board approved this research intervention.

Table 2

University Faculty Participant Demographics (N=218)

Characteristics	N	Percent (%)	Mean	SD
Age (years)	215		49.52	10.80
BMI (kg/ m^2)	215		25.51	5.07
Sedentary Behaviour (h/d)*	173		10.80	3.44
Physical Activity	190			
Active		37.89%		
Moderate		41.05%		
Inactive		21.05%		
Gender	217			
Male		53.00%		
Female		47.00%		
Ethnicity	202			
Caucasian		89.11%		
Asian		5.45%		
Other		5.44%		
Faculty	214			
Faculty of Arts and Humanities		11.68%		
Richard Ivey School of Business		7.01%		
Faculty of Education		2.80%		

Faculty of Engineering		4.21%
Faculty of Health Science		14.02%
Faculty of Information and Media Studies		3.74%
Interdisciplinary Studies		3.27%
Faculty of Law		0.93%
Schulich School of Medicine and Dentistry		17.76%
Don Wright Faculty of Music		1.87%
Faculty of Science		14.95%
Faculty of Social Science		17.76%
Type	216	
Lecturer		13.89%
Assistant		22.69%
Associate		34.26%
Full		25.00%
Other		4.17%
Amount	217	
Full Time		85.71%
Part Time		10.60%
Other		3.69%

Note. BMI = Body Mass Index; h/d = Hours per day; kg = Kilogram; m = Meter; N = Number of participants; SD = Standard Deviation
* Individual sedentary behavior > 24 h/d were not included in calculating mean or SD

Design, Intervention, and Outcome Measures

Survey monkey software was used to create and administer the online survey (Survey Monkey, 2018). The study used a mixed-method approach that collected both quantitative and qualitative data. The survey consisted of 6 sections: letter of information and implied consent, demographics, sedentary behavior questionnaire (modified from Rosenberg et al., 2010), leisure-time physical activity questionnaire (modified from Goldin et al., 1985), likert-scale questions that tapped into perceptions of alternative workstations in the classroom (modified from Benzo et al., 2016), and open-ended questions that allowed students to write about barriers, facilitators, and other issues related to alternative workstations in the classroom.

Statistics

Quantitative analysis. Statistics were completed on SPSS (Statistical Package for the Social Science) software 2016 version 24. Missing data were not included in the analysis. A Chi square analysis was utilized to examine frequency differences between the perceptions of alternative workstations questions. The level of significance was set at .05.

Qualitative analysis. ATLAS.ti was used to assist in coding qualitative data. Answers were uploaded into ATLAS.ti directly from survey monkey (Survey Monkey, 2018). A conventional content analysis with a general inductive approach was used to create qualitative themes (Hsieh and Shannon 2015;Thomas, 2003). Inductive coding was used as existing theory and research literature is limited and no qualitative data on acceptability of alternative workstations in the university classroom had previously been completed. Using the inductive content analysis SS and SD read and coded the data independently and then compared to enhance the data's confirmability. Any inconsistencies were resolved by discussion. This process allowed the categories and names for categories to flow from the data.

Results

Quantitative Data

Perceptions of alternative workstations in the university classroom can be found in Table 3 for university students and in Table 4 for faculty.

Table 3

Student Perceptions of Alternative Workstations in the University Classroom

Outcome	Adjustable Standing Only	Adjustable Sit-Stand	Dynamic Sitting	Chi Square
Q1: Have you every tried				

…				
Yes	15.40%	14.41%	12.59%	$X^2(2)=2.69$, $p=.26$
No	84.60%	85.59%	87.41%	
N	805	805	802	
Chi Square	$X^2(1)=385.40$, $p<.01$	$X^2(1)=407.86$, $p<.01$	$X^2(1)=448.88$, $p<.01$	
Q2: Do you believe … should be made available in the classrooms for students?				
Yes	51.98%	61.99%	34.75%	$X^2(4)=125.56$, $p<.01$
No	22.52%	15.28%	27.00%	
Undecided	25.50%	22.73%	38.25%	
N	808	805	800	
Chi Square	$X^2(2)=127.50$, $p<.01$	$X^2(2)=304.14=$, $p<.01$	$X^2(2)=15.91$, $p<.01$	
Q3: If you answered yes: What classroom size do you think … would be well suited for?				
Small	43.37%	40.31%	38.36%	
Medium	38.23%	38.65%	34.26%	$X^2(6)=23.46$, $p<.01$
Large	11.59%	14.90%	17.13%	
Very Large	6.81%	6.15%	10.25%	
N	506	564	365	
Chi Square	$X^2(3)=347.94$, $p<.01$	$X^2(3)=337.25$, $p<.01$	$X^2(3)=148.56$, $p<.01$	
Q4: If you answered yes: Where would you prefer … to be located?				
Back Row	59.71%	54.26%	32.19%	
Middle Rows	6.86%	10.71%	14.38%	$X^2(8)=210.52$, $p<.01$
Front Row	2.48%	3.16%	11.47%	
Side/End of Rows	21.17%	19.34%	14.38%	
Every Row	9.78%	12.53%	27.57%	
N	504	562	369	
Chi Square	$X^2(4)=740.50$, $p<.01$	$X^2(4)=657.48$, $p<.01$	$X^2(4)=99.78$, $p<.01$	

Q5: If a/an … were available to use in class, I would use it?				
Never	25.44%	18.49%	29.99%	
1 Class	20.20%	22.89%	20.63%	
Irregularly	32.42%	25.03%	19.39%	$X^2(8)=89.12, p<.01$
Regularly	17.17%	21.89%	17.19%	
Always	4.24%	11.70%	12.79%	
N	802	795	727	
Chi Square	$X^2(4)=175.43, p<.01$	$X^2(4)=43.11, p<.01$	$X^2(4)=58.28, p<.01$	

Note. N = Number of participants

Table 4

Faculty Perceptions of Alternative Workstations

Outcome	Adjustable Standing Only	Adjustable Sit-Stand	Dynamic Sitting	Chi Square
Q6: Do you believe … should be made available in the classrooms for students?				
Yes	21.93%	25.00%	19.46%	$X^2(4)=2.82$, $p=.59$
No	39.04%	38.04%	36.22%	
Undecided	39.04%	36.96%	44.32%	
N	187	184	185	
Chi Square	$X^2(2)=10.95$, $p<.01$	$X^2(2)=5.78$, $p=.06$	$X^2(2)=17.85$, $p<.01$	
Q7: If you answered yes: What classroom size do you think … would be well suited for?				
Small	30.59%	34.34%	27.71%	
Medium	34.12%	33.33%	36.14%	$X^2(6)=1.26$, $p=.97$
Large	20.00%	19.19%	22.89%	
Very Large	15.29%	13.13%	13.25%	
N	48	50	39	
Chi Square	$X^2(3)=7.94$, $p<.05$	$X^2(3)=13.12$, $p<.01$	$X^2(3)=9.10$, $p<.05$	
Q8: If you answered yes: Where would you prefer … to be located?				
Back Row	53.95%	47.06%	23.61%	
Middle Rows	7.89%	8.24%	9.72%	$X^2(8)=28.49$, $p<.01$
Front Row	2.63%	2.35%	15.28%	
Side/End of Rows	25.00%	23.53%	22.22%	
Every Row	10.53%	18.82%	29.17%	
N	50	53	40	
Chi Square	$X^2(4)=65.18$, $p<.01$	$X^2(4)=50.82$, $p<.01$	$X^2(4)=8.28$, $p=.08$	

Note. N = Number of participants

Qualitative Data

Themes that emerged from open-ended questions that students answered for alternative workstations in the classroom can be found in Figure 1.

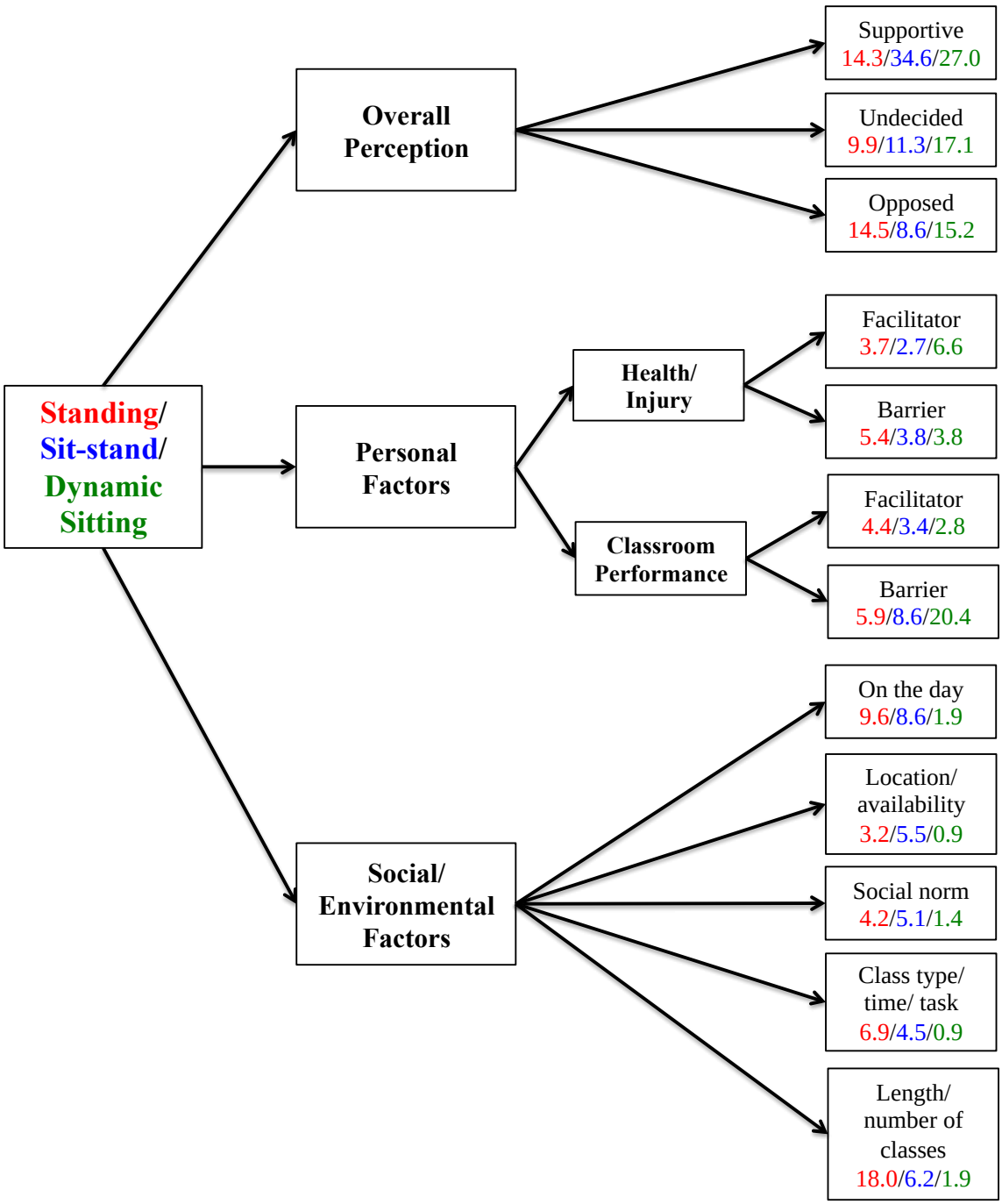

Figure 1. University student qualitative responses (%) of standing (red), sit-stand (blue), and dynamic sitting (green) in the university classroom.

Note. Coloured percentages add up to 100.

Overall, students perceptions of alternative workstations were mixed, as some students were very supportive; “I think it’s a great idea! We spend so much time sitting that it’s important to stand at some points – and in class is a perfect time”, some students were undecided; “I would have to try it out to decide how often I would use one in class”, and some students were against using alternative workstation; “I’m a sitter”. The factors for facilitating alternative workstations included both health benefits (i.e., “sitting hurts my back”) and improved classroom performance (i.e., “standing keeps me alert”). The barriers for alternative workstations use included injuries (i.e., “standing for extended periods of time tend to aggravate the injury”) and perceived diminished classroom performance (i.e., being a distraction for themselves or others; “wouldn’t want to be distracting”). Many students said using alternatives workstations would depend on factors including: the day; “depends on how I’m feeling that day”, location/ availability; “depending on location of standing desks”, social norm; “I would feel weird unless others used it”, class type/task/time “depending on the course”, and the length/ number of classes; “depending on the number of classes that day”. A table containing all the quotes can be found in the Appendix.

Discussion

Using a mixed-method approach, one purpose of this study was to quantitatively determine the perceptions of university students and faculty in using alternative workstations (standing, sit-stand, and dynamic sitting) in the classroom. The current findings are in line with results reported by Benzo et al. (2016). Specifically we found that a large portion of students believed standing (51.98%) and sit-stand (61.99%)

options should be available in the university classroom (Table 3, Q2). However, many students still remained undecided (standing 25.50% and sit-stand 22.73%) or against implementation (standing 22.52% and sit-stand 15.28%). This is not surprising, as only a small portion (i.e., 12-15%) of students had tried alternative workstations (Table 3, Q1) given the ubiquitous nature of sitting during classroom lectures. These neutral and negative perceptions will likely change when more students experience using alternative workstation. Further, students were less in favor of implementing dynamic sitting (34.75%) options in the university classroom. Similar to faculty results from Benzo et al. (2016); students believe standing (43.37% and 59.71%) and sit-stand (40.31% and 54.26%) options are best for small classes and in the back row, respectively (Table 3, Q3 and Q4). Students were more variable on the best location for dynamic sitting options (Table 3, Q3 and Q4). In order to mitigate visibility concerns, standing and sit-stand desks should be placed in the back row of university classrooms. As dynamic sitting chairs do not pose a visibility concern, they could be placed in any row. If alternative workstations were available in the university classroom, 74.56%, 81.51%, and 70.01% of students stated they would use standing, sit-stand, and dynamic sitting postures for at least 1 class, respectively (Table 3, Q5).

Contrary to results from Benzo et al. (2016); faculty were much less supportive of implementing standing (21.93%), sit-stand (25.00%), and dynamic sitting (19.46%) options in the university classroom than students (Table 4, Q6). Since alternative workstations in the classroom are not directly benefiting faculty members they may be less supportive. Perhaps educating faculty on the benefits of alternative workstations will increase their support. Further, in contrast to results from Benzo et al. (2016),

faculty members were more conflicted on the best class size and location of alternative workstations (Table 4, Q7). However, like students tended to prefer the back and side rows of small and medium classrooms.

Another purpose of the present study was to qualitatively examine the barriers, facilitators, and other issues with using alternative workstations in the university classroom (Figure 1; Appendix). The qualitative information provided in this study allowed for a more in depth look at students' perceptions of alternative workstations in the university classroom. The qualitative information also informed some of the quantitative findings. For example, one of the reasons dynamic sitting options were less preferred could be that many students see them as very distracting and negatively impacting their classroom performance (Table 3, Q2 and Q5; Figure 1, Classroom Performance, Barrier). Furthermore, students were more concerned with the location and visibility of standing and sit-stand options than dynamic sitting options, which could explain why they were more undecided on the best location of dynamic sitting options (Table 3, Q3 and 4; Figure 1, Location). Additionally, students were the most supportive and least opposed to sit-stand workstations, which could explain why students are most in favor of sit-stand implementation and use (Table 3, Q2 and 5; Figure 1, Overall Perception). These factors must be considered when designing interventions to reduce sedentary behavior or when implementing alternative workstations. We acknowledge however that there are many feasibility (i.e., university policy and procedures), financial (i.e., cost of alternative workstations and classroom modifications), and structural (i.e., visibility and access issues) challenges for implementing alternative workstations in the university classrooms.

There are several strengths with the present study. First, the large student sample size allowed for less chance of type 2 statistical error. Second, the collection of both quantitative and qualitative data allowed for a comprehensive and complementary assessment of perceptions of alternative workstations in the university classroom. Third, the participants were both university students and faculty from a wide range of disciplines and ages. Fourth, the survey collected data on a variety of possible alternative workstations for the university classroom (standing, sit-stand, and dynamic sitting). Finally, the study targeted an important population—university students who spend a substantial amount of time being sedentary and may as a result be at risk of health problems.

Despite these strengths, there are several limitations that must be acknowledged. First, participants volunteered to complete the survey, not all participants completed all the survey questions, and a smaller number of faculty members completed the survey than students. Hence, we can only speculate that our findings are representative. Second, the effect of demographic factors on perceptions of alternative workstations was not addressed and should be considered in future research. Lastly, this was the first study to combine quantitative and qualitative perceptions of university students and faculty towards standing, sit-stand, and dynamic sitting in the university classroom and must be replicated before findings can be universally accepted.

Conclusion

Students are forced to sit for all their lectures, which translates to large amounts of forced sedentary behavior and this in turn may have negative health consequences. A substantial portion of students believe standing, sit-stand, and to a lesser extent dynamic sitting options should be available for use in university classroom lectures. Most students also state that they will use these options (at various levels of engagement) if they are available in the university classroom. Students and faculty prefer alternative desks to be located in the back of small classes. Hence, at this time we recommend providing standing, sit-stand, and to a lesser extent dynamic sitting options in university classrooms to allow students to receive health benefits as they learn.

References

Benzo, R. M., Gremaud, A. L., Jerome, M., & Carr, L. J. (2016). Learning to stand: the acceptability and feasibility of introducing standing desks into college classrooms. *International Journal of Environmental Research and Public Health*, 13, 823. DOI: 10.3390/ijerph13080823

Cotten, E., & Prapavessis, H. (2016). Increasing nonsedentary behaviors in university students using text messages: randomized controlled trial. *JMIR MHealth and UHealth*, 4(3), 99. DOI: 10.2196/mhealth.5411

Goldin, G. & Shephard, R. J. (1985). A simple method to access behavior in the community. *Canadian Journal of Applied Sport Science, 10*, 141-146

Graves, L. E. F., Murphy, R. C., Shepherd, S. O., Cabot, J., & Hopkins, N. D. (2015). Evaluation of sit-stand workstations in an office setting: a randomized controlled trial. *Public Health,* 15(1), 1145. DOI: 10.1186/s12889-015-2469-8

Hsieh, H. F. and Shannon, S. E. 2015. "Three Approaches to Qualitative Content Analysis." *Qualitative Health Research* 15 (9): 1277-1288. doi: 10.1177/1049732305276687

Lee, P. H., & Wong, K. Y. (2015). The association between time spend in sedentary behaviors and blood pressure: a systematic review and meta-analysis. *Sports Medicine,* 45(6), 867- 880. DOI: 10.1007/s40279-015-0322-y

Prapavessis, H., Gaston, A., & DeJesus, S. (2015). The Theory of planned behavior as a model for understanding sedentary behavior. *Psychology of Sport and Exercise*, 19, 23-32. DOI: https://doi.org/10.1016/j.psychsport.2015.02.001

Rosenberg, D. E., Normal, G. J., Wagner, N., Patrick, K., Calfas, K. J., & Sallis, J. F. (2010). Reliability and Validity of the Sedentary Behavior Questionnaire (SBQ) for Adults. *Journal of Physical Activity and Health, 7*(6), 697-705.

Sedentary Behaviour Research Network. (2012). *Statement on the Standardized Use of the terms "sedentary" and "sedentary behaviours."* Retrieved from www.sedentarybehaviour.org

Survey Monkey (2018). *Survey Monkey.* Retrieved from https://www.surveymonkey.com/

Schmid, D., & Leitzmann, M. F. (2014). Television viewing and time spent sedentary in relation to cancer risk: a meta-analysis. *Journal of the National Cancer Institute,* 106(7). DOI: 10.1093/jnci/dju098

Smith, S., & Prapavessis, H. (2017). "Standing up" for students: effects on classroom performance. *International Journal of Ergonomics,* 7(1). DOI: http://www.cscjournals.org/manuscript/Journals/IJEG/Volume7/Issue1/IJEG-44.pdf

Teychenne, M., Ball, K., & Salmon, J. (2010). Sedentary behavior and depression among adults: a review. *International Journal of Behavior Medicine,* 17(4), 246-254. DOI: 10.1007/s12529-010-9075-z

Thomas, D. R. (2003). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation, 27*(2), 237-246. DOI: 10.1177/1098214005283748

Wilmot, E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Gray, L. J., Khunti, … Biddle, S. J. H. (2012). Sedentary time in adults and the association

with diabetes, cardiovascular disease and death: systematic review. *Diabetologia,* 55(11), 2895-2905. DOI: 10.1007/s00125-012-2677-z

Wong, T. S., Gaston, A., DeJesus, S., & Prapavessis, H. (2016). The utility of a protection motivation theory framework for understanding sedentary behavior. *Health psychology and behavioral medicine*, 4(1), 29-48. DOI: http://dx.doi.org/10.1080/21642850.2015.112833

CHAPTER 5: Overall Conclusion

Students are forced to sit for all their lectures, which translates to large amounts of forced sedentary behavior and this in turn may have negative health consequences. This thesis investigated the classroom performance effects and perceptions of alternative postures in the university classroom.

In Chapter 2 (Pilot Study 1) university students (N=40) listened to three 3-minute videos while simultaneously performing a typing task, followed by three quizzes pertaining to the videos, and rated their perception after each desk condition using a randomized counterbalanced design. This study provides preliminary evidence suggesting that there is no difference between classic sitting, dynamic sitting, and standing desks on classroom performance of university students. Furthermore, those participants rated the desks equally on ease and enjoyment.

In Chapter 3 (Pilot Study 2) university students (N=20) listened to three 50-minute lectures followed by three quizzes pertaining to the lectures, performed cognitive tasks, and rated perceptions after each desk condition using a randomized counterbalanced design. This study provides further evidence that there is no difference between classic sitting, dynamic sitting, and standing desks on classroom performance of university students. Furthermore, cognitive performance, enjoyment, and focus do not suffer by changing students' anatomical position from classic sitting. However, standing posture may cause more discomfort and difficulty for some students.

In Chapter 4 (Study 3), university students' (N=1005) and faculty' (N=218) acceptability to alternative workstations in the university classroom was assessed using a mixed method approach. This study provides evidence that a substantial portion of

students' believe standing, sit-stand, and to a lesser extent dynamic sitting options should be available for use in university classroom lectures. Most students also state that they will use these options (at various levels of engagement) if they are available in the university classroom. Students and faculty prefer alternative desks to be located in the back of small classes. In sum, implementation of alternative workstations is supported by students and to a lesser extent faculty.

Hence, at this early stage of inquiry there is no evidence to recommend against providing dynamic sitting, sit-stand, and standing options in the university classroom to allow students to receive health benefits as they learn.

Appendix

Appendix A – Chapter 2: Standing and Dynamic Sitting in the University Classroom: A Pilot Study

Appendix A.1 – Ethics Documents

A.1.1 Recruitment Poster

Western

PARTICIPANTS NEEDED FOR RESEARCH ON REDUCING SEDENTARY TIME

We are looking for volunteers to take part in a study of the effects of sitting, dynamic sitting, and standing desks on classroom performance. Students 18 to 30 years of age are eligible to participate.

If you are interested and agree to participate you would be asked to complete 3 consecutive 3minute classroom tasks. Each 3-minute session will use a different type of desk. The three desks to be used are a sitting, dynamic sitting, and standing desk. Each 3-minute session will contain a typing and auditory task.

For more information about this study, or to volunteer for this study please contact:
Siobhan Smith

A.1.2 Ethics Approval

Western Research

Research Ethics

Western University Non-Medical Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Prof. Harry Prapavessis
Department & Institution: Health Sciences\Kinesiology,Western University

NMREB File Number: 107403
Study Title: The effects of sitting, dynamic sitting, and standing desks on classroom performance of students
Sponsor:

NMREB Initial Approval Date: February 02, 2016
NMREB Expiry Date: February 02, 2017

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Letter of Information & Consent		2015/12/10
Advertisement	Advertisement	2015/12/10
Western University Protocol	Received December 11, 2015.	

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

A.1.3 Letter of Information/ Consent

The effects of sitting, dynamic sitting, and standing desks on classroom performance in students.
Letter of Information and Consent
Siobhan Smith
Dr. Harry Prapavessis

Introduction

- You are invited to participate in this research study about of the effects of sitting, dynamic sitting, and standing desks on classroom performance because you are a student between 18-30 years old.

Study

- The purpose of this study is to determine if there is a difference in classroom stimulated performance when using sitting, dynamic sitting, and standing desks. Decreasing sedentary is beneficial for ones health. If classroom performance is equal between desks then a standing desk would be an easy way for students to reduce sedentary time and improve their health.
- If you agree to this study you will be asked to perform 3 consecutive 3minute classroom stimulations.
- Each 3-minute session will use a different type of desk. The three desks to be used are a sitting, dynamic sitting, and standing desk. Each 3-minute session will contain a typing and auditory task.
- The study will occur in the kinesiology laboratory in Thames Hall at the University of Western Ontario
- The measurements recorded will be the speed and accuracy of typing and the accuracy of answering questions from the auditory recording
- There are no known or anticipated risks or discomforts associated with participating in this study.
- You may not directly benefit from participating in this study but information gathered may provide benefits to society as a whole which include increased use of dynamic sitting and standing desks in classrooms decreasing the sedentary time of students.

Right to refuse or withdraw

- The decision to participate in this study is entirely up to you. You may refuse to take part in this study at any time.
- If you decide to withdraw from the study, you have the right to request withdrawal of information collected about you. If you wish to have your information removed please let the researcher know.
- Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not

answer individual questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time it will have no effect on your [care/employment status/academic standing - choose only those that are applicable].
- We will give you new information that is learned during the study that might affect your decision to stay in the study.
- You do not waive any legal right by signing this consent form

Confidentiality
- This study is anonymous. We will not be collecting or retaining any information about your identity.
- The results from this study can be presented and published.

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 my supervisor or me before, during, or after the research.
- If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics

Consent

The effects of sitting, dynamic sitting, and standing desks on classroom performance in students.

Letter of Information and Consent

Siobhan Smith
Dr. Harry Prapavessis

- Your signature below indicated 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.
- I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Subject's Name (print): _____ Date _____
Subjects Signature: _____ Date _____
Investigator's Signature: _____ Date _____

Appendix A.2 - Research Documents

A.2.1 Demographic Questionnaire

Age _____

Gender _____

Program _____

Year _____

Ethnicity _____

A.2.2 Typing Passages

Paragraph 1:

The Lion is one of the five big cats. It is the second largest after the tiger. The mane of the adult male lion is one of the distinctive characteristics of the species. The darker and fuller the main: the healthier the lion. Lions squander plenty of their time resting and are inactive for generally twenty hours per day. Lions are social animals and largely live in groups called prides.

Paragraph 2:

The gray wolf is the largest member of its family. Wolves are very territorial animals that form territories far larger than needed to survive in order to assure a steady fill or prey. The gray wolf is often monogamous, mated pairs mostly remain together for life. Smell is their most acute sense and plays a key role in communication. The gray wolf is a social animal that lives in packs.

Paragraph 3:

The great white shark can live for over seventy years and grow over six meters in length. It has no natural predators other than the killer whale. They can be found in the costal surface waters of all the major oceans. They are carnivorous ambush hunters, taking prey by surprise from below and can detect variations in the electromagnetic field of animals of half a billion of a volt.

A.2.3 Video Quizzes

Video 1: http://www.tubechop.com/watch/7581907

1. Telling someone your goal makes it?

a) More likely to happen

b) Less likely to happen

c) Just as likely to happen

d) Never happen

e) Impossible to happen

f) Always happen

2. Which correctly matches the psychologist year and contribution?

a) 1982: Peter Gollwitzer – New tests

b) 1930: Wera Mahlet – When it was acknowledges by others it did not feel real in the mind

c) 2009: Peter Gollwitzer – Wrote a book

d) 1986: Kurt Lewin – New tests

e) 1945: Were Mahlet – Wrote a book

f) 1926: Kurt Lewin - Substitution

3. During the example study where half the group announced their goal and half didn't which of the following is correct:

a) 100 people were used across 5 tests were used

b) Everyone was given 1 hour of work

c) Those who kept their mouth shut worked the entire time on average

d) Those who kept their mouth shut felt much closer to achieving their goal

e) Those who announced their goal felt they had a long way to go to achieve their goal

f) Those who announced it worked the entire time on average

Video 2: http://www.tubechop.com/watch/7581936

1 Which of the following is true

a) You cannot do things for 30 days

b) The speaker couldn't write a book in 30 days

c) Big crazy challenges are more likely to stick

d) The speaker climbed mount Everest

e) The speaker took a picture every day for 30 days

f) Small changes were less sustainable

2 The speaker followed in the footsteps of the great American philosopher

a) Morgan Spurlock

b) Martin Smith

c) Milo Sanders

d) Malcolm Stewart

e) Manuel Snow

f) Mark Spano

3 A few things he learned and gained from the 30-day challenges include

a) The time was much less memorable

b) His self confidence grew

c) He could write a 100 000 word novel

d) None of the above

e) All of the above

f) 2 of the above

Video 3: http://www.tubechop.com/watch/7581969

1 What is true about sitting?

a) People are sitting more than they are sleeping

b) Sitting has not become the smoking of our generation

c) People are sitting less than 7 hours a day

d) Because everyone else is doing it, it occurs to us that it is not ok

e) People sit less than they use their phones

f) People are sleeping less than 6 hours a day on average

2 Health consequences of sitting include:

a) Breast cancer 10%

b) Colon cancer 10%

c) Heart disease 6%

d) Type two diabetes 7%

e) 3 of the above

f) All of the above

3 Walking meeting are good for

a) You can take care of your health but not obligations

b) Not getting out of the box because it never leads to out of the box thinking

c) Nothing, it's a terrible idea

d) Reframing problems so both can be true (i.e. health and obligations)

e) Taking care of obligations but it's bad for your health

f) Walking meetings started because the speaker was scared of sitting

A.2.4 Self-Reported Measure Questionnaire

Rate your ease and enjoyment from 1 to 5 for using this desk.

1	2	3	4	5
Very Difficult	Somewhat Difficult	Neutral	Somewhat Easy	Very Easy

Appendix A.3 – Copyright

From: http://www.cscjournals.org/authors/open-access-license-copyrights.php

OPEN ACCESS LICENSE & COPYRIGHTS POLICY

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Appendix B – Chapter 3: Standing and Dynamic Sitting in the University Classroom: A Real Possibility

Appendix B.1 - Ethics Documents

B.1.1 Recruitment Poster

Western

PARTICIPANTS NEEDED FOR RESEARCH ON REDUCING SEDENTARY TIME

We are looking for volunteers to take part in a study of the effects of sitting, dynamic sitting, and standing desks on classroom performance. Students 18 to 30 years of age are eligible to participate.

Participants will be compensated 30$ for 3 hours of their time.

If you are interested and agree to participate you would be asked to complete 3-hours of desk use. Each hour session will use a different type of desk. The three desks to be used are a sitting, dynamic sitting, and standing desk. For each desk you will be asked to listen to and answer questions about a university lecture and perform other short cognitive tasks.

For more information about this study, or to volunteer for this study please contact:
Siobhan Smith

B.1.2 Ethics Approval

Western Research

Research Ethics

Western University Non-Medical Research Ethics Board
NMREB Amendment Approval Notice

Principal Investigator: Prof. Harry Prapavessis
Department & Institution: Health Sciences\Kinesiology,Western University

NMREB File Number: 107403
Study Title: The effects of sitting, dynamic sitting, and standing desks on classroom performance of students

NMREB Revision Approval Date: February 15, 2017
NMREB Expiry Date: February 02, 2018

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Western University Protocol	Received January 31, 2017.	
Advertisement		2017/01/27
Instruments	Questionnaire - Received January 31, 2017.	
Revised Letter of Information & Consent		2017/01/27

The Western University Non-Medical Science Research Ethics Board (NMREB) has reviewed and approved the amendment to the above named study, as of the NMREB Amendment Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

B.1.3 Letter of Information/ Consent

The effects of sitting, dynamic sitting, and standing desks on classroom performance in students.
Letter of Information and Consent
Siobhan Smith –
Dr. Harry Prapavessis –

Introduction

- You are invited to participate in this research study about of the effects of sitting, dynamic sitting, and standing desks on classroom performance because you are a student between 18-30 years old.

Study

- The purpose of this study is to determine if there is a difference in classroom stimulated performance when using sitting, dynamic sitting, and standing desks. Decreasing sedentary is beneficial for ones health. If classroom performance is equal between desks then a standing desk would be an easy way for students to reduce sedentary time and improve their health.
- If you agree to this study you will be asked to perform 3-hours of desk use.
- Each 1-hour session will use a different type of desk. The three desks to be used are a sitting, dynamic sitting, and standing desk. For each desk you will be asked to listen to and answer questions about a university lecture and perform other short cognitive tasks.
- You will be compensated 30$ for 3-hours of your time.
- The study will occur in the kinesiology laboratory in Thames Hall at the University of Western Ontario
- The measurements recorded will be the speed and accuracy of cognitive tasks and the accuracy of answering questions from the auditory lecture.
- There are no known or anticipated risks associated with participating in this study.
- You may not directly benefit from participating in this study but information gathered may provide benefits to society as a whole which include increased use of dynamic sitting and standing desks in classrooms decreasing the sedentary time of students.

Right to refuse or withdraw

- The decision to participate in this study is entirely up to you. You may refuse to take part in this study at any time.

- If you decide to withdraw from the study, you have the right to request withdrawal of information collected about you. If you wish to have your information removed please let the researcher know.
- Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time it will have no effect on you.
- We will give you new information that is learned during the study that might affect your decision to stay in the study.
- You do not waive any legal right by signing this consent form

Confidentiality

- This study is anonymous. We will not be collecting or retaining any information about your identity.
- The results from this study can be presented and published.

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 my supervisor or me before, during, or after the research.
- If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics

Consent

The effects of sitting, dynamic sitting, and standing desks on classroom performance in students.

Letter of Information and Consent

Siobhan Smith –

Dr. Harry Prapavessis –

- Your signature below indicated 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.
- I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Subject's Name (print): _____ Date _____

Subjects Signature: _____ Date _____

Investigator's Signature: _____ Date _____

Appendix B.2 – Research Documents

B.2.1 Demographics Questionnaire

Age _____

Gender _____

Program _____

Year _____

Ethnicity _____

Weight _____

Height _____

B.2.2 Lecture Quizzes

Lecture 1: Exercise During Pregnancy: What are the guidelines? Dr. Michelle Mottola

Multiple Choice

1. ___ % of adults above ____ age are now obese and maternal obesity is _____.

a) 20% of adults above 30 years of age are now obese and maternal obesity is 30%.

b) 30% of adults above 20 years of age are now obese and maternal obesity is 40%.

c) 15% of adults above 40 years of age are now obese and maternal obesity is 20%.

d) 5% of adults above 50 years of age are now obese and maternal obesity is 50%.

e) 80% of adults above 25 years of age are now obese and maternal obesity is 90%.

f) 90% of adults above 60 years of age are now obese and maternal obesity is 10%.

2. Women should exercise between _____ on the Borg's rating of perceived exertion.

a) 12 - 14

b) 11 - 13

c) 10 - 15

d) 13 - 14

e) 10 - 11

f) 13 – 16

3. Appropriate physical activity during pregnancy…..

a) Increases metabolic and cardiopulmonary reserve

b) Promotes normal glucose tolerance

c) Has psychological benefits

d) Damages the placenta and fetus

e) All of the above

f) 3 of the above

4. Which of the following statements is true?

a) Maternal obesity and excessive pregnancy weight gain is linked to small babies and childhood obesity.

b) The fetal environment is not important and cannot impact chronic disease risk in infants.

c) The rat study in which the mother was fed junk food showed decreased preference of junk food for the baby.

e) During exercise, the target heart rate zone should be held for a maximum of 30 minutes.

f) It is safe to lie flat on your back past 16 weeks of pregnancy.

g) Pre-pregnancy weight is a minor determinant of pregnancy weight gain.

5. PARmed-x can be used by...

a) Physicians

b) Midwifes

c) Fitness professionals

d) None of the above

e) 2 of the above

f) All of the above

Fill in the Blank

1. **Physical inactivity** is the link between obesity and chronic risk factors later in life.

2. During pregnancy, a woman should think of not eating for two but eating **twice as healthy**.

3. Prior to **1985** there were no physical activity guidelines for pregnant woman and pregnant women were simply told to rest.

4. In a **talk test** the exercise intensity is excessive if you cannot carry on a verbal conversation while exercising.

5. Structured exercise frequency during late pregnancy appears to be a determinant of birth rate. It is recommended to exercise **3-4** times per week.

Lecture 2: Strategies for Overcoming Depression. Dr. David Dozois

Multiple Choice

1. Which of the following statements is/are true?

a) Depression affects people individually.

b) Depression affects the individual emotionally.

c) Depression affects society as a whole.

d) Depression affects the individual cognitively.

e) Two of the above

f) All of the above

2. Which of the following statements is true?

a) You can't be depressed without experiencing sadness.

b) Approximately 10 thousand Canadians experience clinical depression in a given year.

c) Men are twice as likely as women to become depressed.

d) Depression can occur at any age.

e) The only effective treatment of depression is medication.

f) Depression is the second most common cause of disability in the Canadian labor force.

3. For people with depression…

a) If a negative thing happens they attribute it to be an internal, stable and specific cause.

b) If a negative thing happens they attribute it to be an internal, stable and global cause.

c) If a negative thing happens they attribute it to be an external, unstable, and specific cause.

d) If a negative thing happens they attribute it to be an external, unstable, and global cause.

e) If a negative thing happens they attribute it to be an external, stable, and specific cause.

f) If a negative thing happens they attribute it to be an internal, unstable, and specific cause.

4. The assumption(s) of cognitive behavioral therapy is/are…

i) Cognitive activity affects behavior and mood.

ii) Cognitive activity may be monitored and altered.

iii) Desired emotional and behavioral change may be affected through cognitive change.

a) i

b) i and ii

c) ii

d) i and iii

e) ii and iii

f) i, ii, and iii

5. Cognitive behavioral therapy deals with three primary activities _____.

a) Self reflection, teamwork, and communication

b) Music, exercise, and meditation

c) Education, skill building, and problem solving

d) Medication, perseverance, and working with a councilor

e) Knowledge, trust, and happiness

f) Acceptance, understanding, and learning

Fill in the Blank

1. Depression effects **10%** of the population.

2. To be diagnosed with depression, you must have at least **five** out of nine symptoms.

3. Cognitive therapy is **equally/as** effective to medication for severe depression long term.

4. People who are depressed take longer to name the colours of **negative** words.

5. Cognitive behavior therapy is based on the theory that the way people think has a strong effect on how we feel and how we behave.

Lecture 3: Eat Drink and be Wary. Dr. Rob Lannigan

Multiple Choice

1. Which of the following statements is true?

a) Bacteria cannot live (grow and multiply) on their own.

b) Virus and fungi can live (grow and multiply) on their own.

c) Bacteria and Virus are the same thing.

d) Fungi cannot live (grow and multiply) on their own.

e) Virus cannot live (grow and multiply) on their own.

f) Fungi and Virus are the same thing.

2. Which of the following statements is true?

a) In low-income countries benefits of small scale production and distribution are offset by the lack of hygiene and enforced regulations.

b) In high-income countries benefits of small scale production and distribution are offset by the lack of hygiene and enforced regulations.

c) In low-income countries the dangers of small scale production and distribution are offset by the lack of hygiene and enforced regulations.

d) In high-income countries the dangers of small scale production and distribution are offset by the lack of hygiene and enforced regulations.

e) In low-income countries benefits of small scale production and distribution are offset by the great of hygiene and enforced regulations.

f) In medium-income countries benefits of small scale production and distribution are offset by the great of hygiene and enforced regulations.

3. Contamination of food can occur during…

a) Production (field and feed).

b) Processing (slaughter and slice).

c) Serving (cook and kitchen).

d) All of the above

e) 2 of the above

f) None of the above

4. Food poisoning…

a) Occurs when food is the vehicle for the ingestion of a microbial organism, which may then establish itself in the host and cause disease, either by a toxin or by invasion.

b) Is from consuming something, which may be food, contaminated by toxins, which could be chemical or microbial in origin.

c) Is more common than food associated infections.

d) Symptoms occur after days to weeks.

e) As a form of murder, is at present, easy to get away with.

f) None of the above

5. Which of the following statements is true?

a) Our food is very unsafe.

b) Ground beef can safely be eaten raw.

c) Our food is generally safe.

d) Listeria is fatal 100% of the time.

e) You will never get sick by eating raw oysters.

f) Salmonella cannot be found in eggs.

Fill in the Blank

1. For every disease sample, approximately **100** people actually had the disease but were never reported.

2. As of the year 2000, E. coli can be found in **water**.

3. The Chinese used **ivory chopsticks** to detect poisoning.

4. Today food travels approximately **2000** km.

5. Bioterrorism is not a very likely form of terrorism.

B.2.3 Self-Reported Measures Questionnaire

QUESTIONAIRE AFTER EACH DESK

Rate your discomfort from 0 to 5 for using this desk.

0	1	2	3	4	5
No Discomfort	Some Discomfort	Mild Discomfort	Moderate Discomfort	Severe Discomfort	Very Severe Discomfort

Rate your ease from 1 to 5 for using this desk.

1	2	3	4	5
Very Difficult	Somewhat Difficult	Neutral	Somewhat Easy	Very Easy

Rate your enjoyment from 1 to 5 for using this desk.

1	2	3	4	5
Very Unenjoyable	Somewhat Unenjoyable	Neutral	Somewhat Enjoyable	Very Enjoyable

Rate your focus/concentration from 1 to 5 for using this desk.

1	2	3	4	5
Very Unfocused	Somewhat Unfocused	Neutral	Somewhat Focused	Very Focused

FINAL QUESTIONAIRE

If a standing desk were available to use in class how likely would you be to use it from 1 to 5.

1	2	3	4	5
Very Unlikely	Somewhat Unlikely	Neutral	Somewhat Likely	Very Likely

If a dynamic sitting desk were available to use in class how likely would you be to use it from 1 to 5.

1	2	3	4	5
Very Unlikely	Somewhat Unlikely	Neutral	Somewhat Likely	Very Likely

Appendix C – Chapter 4: Standing and Dynamic Sitting in the University Classroom: Perceptions of Students and Faculty

Appendix C.1 - Ethics Documents

C.1.1 Recruitment Poster

Western

PARTICIPANTS NEEDED FOR RESEARCH ON REDUCING SEDENTARY TIME

We are looking for volunteers to take part in a survey on sedentary behavior and alternative workstations. University students 18 to 30 years of age and fluent in English are eligible to participate.

Participants will be entered in a draw to win 200$ to the Western Book Store.

If you would like to participate in this study please copy and past the link below to access the letter of information and survey link.

https://www.surveymonkey.com/r/3BNKFTZ

For more information about this survey please contact:
Siobhan Smith

C.1.2. Recruitment Email Script

Email Script for Recruitment

Subject Line: Invitation to participate in survey

Hello,

We have received your email address from the University of Western Ontario online public faculty profiles. You are being invited to participate in a survey that we, Siobhan Smith and Dr. Harry Prapavessis are conducting. Briefly, the 15-minute online survey involves collecting information on the sedentary behavior, physical activity, and perceptions of alternative workstations of faculty.

If you would like to participate in this study please click on the link below to access the letter of information and survey link.

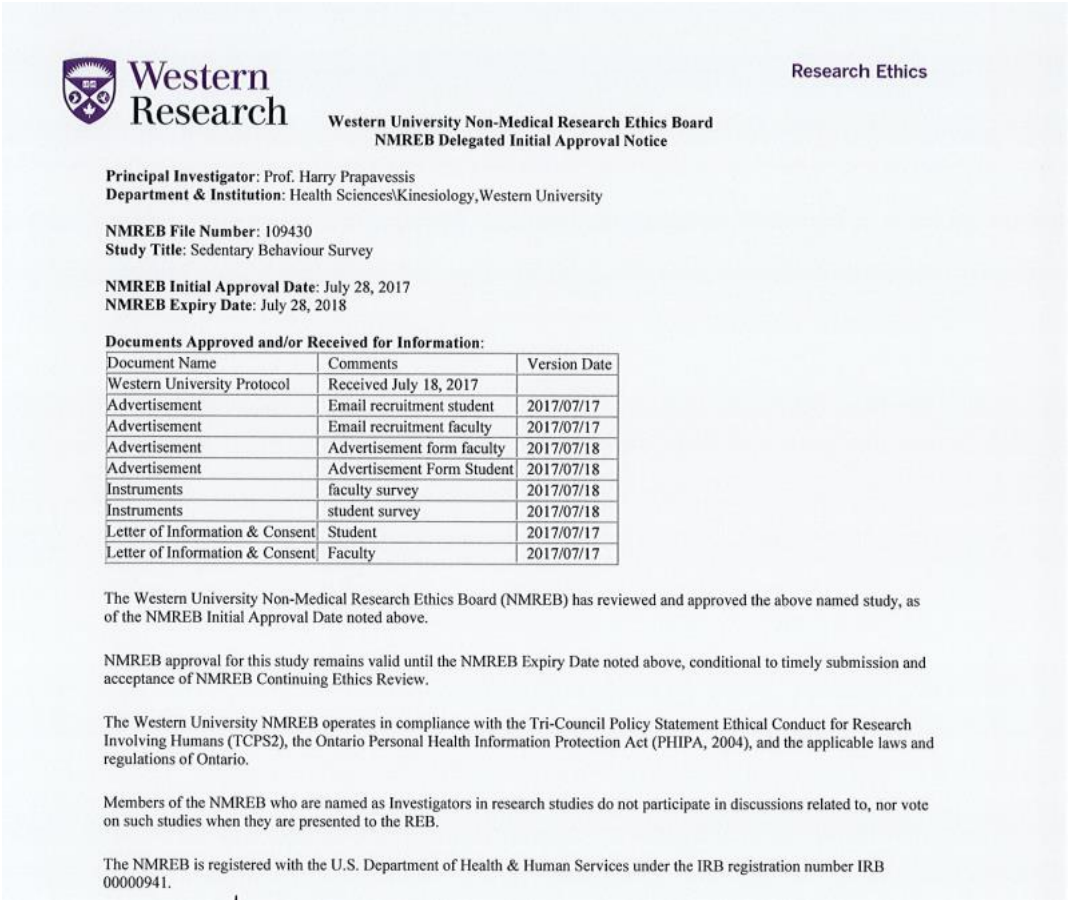
https://www.surveymonkey.com/r/3G6QGVY

Thank you,

Siobhan Smith

Dr. Harry Prapavessis

C.1.3 Ethics Approval



Western Research

Research Ethics

Western University Non-Medical Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Prof. Harry Prapavessis
Department & Institution: Health Sciences\Kinesiology,Western University

NMREB File Number: 109430
Study Title: Sedentary Behaviour Survey

NMREB Initial Approval Date: July 28, 2017
NMREB Expiry Date: July 28, 2018

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Western University Protocol	Received July 18, 2017	
Advertisement	Email recruitment student	2017/07/17
Advertisement	Email recruitment faculty	2017/07/17
Advertisement	Advertisement form faculty	2017/07/18
Advertisement	Advertisement Form Student	2017/07/18
Instruments	faculty survey	2017/07/18
Instruments	student survey	2017/07/18
Letter of Information & Consent	Student	2017/07/17
Letter of Information & Consent	Faculty	2017/07/17

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Appendix C.2 - Research Documents

C.2.1 Student Survey

Letter of Information

Western

Student Sedentary Behavior Survey.

Letter of Information

Introduction

- You are invited to participate in this research study about sedentary behavior and alternative workstations because you are a university student greater than 18 years old fluent in English.

Study

- The purpose of this study is to collect information on the sedentary behavior, physical activity, and perceptions of alternative workstations of university students.
- Almost all questions are in multiple-choice format. Example questions can be found below:

"On a typical weekday, how much time do you spend (from when you wake up until you go to bed) doing the following? Sitting and watching TV. None, 15 min or less, 30 min, 1 hr, 2 hrs, 3 hrs, 4 hrs, 5 hrs, 6 hrs, 7 hrs, 8 hrs, 9 hours or more"

"Have you ever tried an adjustable standing only desk? Yes, No"

- The survey will take approximately 15 minutes to complete.
- If you agree to this study you will be asked to complete one short survey.
- By providing your email you will be entered in a draw to win 200$ to the Western Book Store. Your email address will be stored online. Only the principal investigator Dr. Prapavessis and Co-investigator Siobhan Smith will have access to your email address. The email address will only be used to contact the winner of the gift card. Deleting all the files and links will destroy the email addresses.
- There are no known or anticipated risks associated with participating in this study.
- You may not directly benefit from participating in this study but information gathered might provide benefits to society as a whole, which include increased use of standing desks in university classrooms decreasing the sedentary time of students.

Right to refuse or withdraw

- The decision to participate in this study is entirely up to you. You may refuse to take part in this study at any time.
- Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time it will have no effect on you.
- You do not waive any legal right by signing this consent form.

Confidentiality

- This study is anonymous. We will not be collecting or retaining any information about your identity.
- The results from this study can be presented and published.
- Representatives of The University of Western Ontario Non-Medical Research Ethics Board may require access to your study-related records to monitor the conduct of the research.

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 my supervisor (Dr. Harry Prapavessis) or me (Siobhan Smith) before, during, or after the research.
- If you have any questions about your rights as a research participant or the conduct of this

Demographic Questionnaire

1. What is your gender?

2. What is your age?

3. What is your weight in kg or lb?

4. What is your height in cm or inches?

5. What is your current program?

Undergraduate

Graduate (Masters)

Graduate (Doctorate)

Graduate (Post Doctorate)

Other (please specify)

6. Are you a part time or full time student?

Part Time

Full Time

Other (please specify)

7. What faculty are you in?

Faculty Arts And Humanities

Richard Ivey School of Business

Certificates and Diplomas

Faculty of Education

Faculty of Engineering

The School of Graduate and Post-Doctoral Studies

Faculty of Health Sciences

Faculty of Information and Media Studies

Inter-Faculty Departments/ Modules/ Programs

Faculty of Law

Schulich School of Medicine & Dentistry

Don Write Faculty of Music

Faculty of Science (including BMSc)

Faculty of Social Science

Other (please specify)

8. What year of your current program are you in?

9. What is your ethnicity (i.e. caucasian or hispanic)?

Sedentary Behavior Questionnaire

Sedentary Time - Weekdays

On a typical weekday, how much time do you spend (from when you wake up until you go to bed) doing the following?

10. Sitting while watching TV

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

11. Sitting while using the computer for recreational purposes (i.e., games, Facebook, YouTube, movies, music, Skype, social media websites, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

12. Sitting for school (working at the computer, talking on the phone, studying, reading, sitting in lecture or meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

13. Sitting for paid or unpaid (volunteer) work (working at the computer, talking on the phone, office work, reading, sitting in meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

14. Sitting while reading for pleasure

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

15. Sitting while listening to music

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

16. Sitting while playing a music instrument

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

17. Sitting while doing arts and crafts (e.g., scrapbooking, cardmaking, painting, drawing)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

18. Sitting in a motor vehicle in order to get to paid or unpaid (volunteer) work or school (i.e., commuting in a car or sitting in a bus or train)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

19. Sitting in a motor vehicle for leisure-related transportation purposes (i.e., sitting in a car, bus, or train to get to and from recreational activities, visiting friends or family, going out, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

20. Sitting while eating

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

21. Sitting while socializing/ visiting or non-work related phone conversations (e.g., talking with a friend, family member, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

22. Sitting for religious or spiritual pursuits (e.g., meditation, prayer, sitting in church or other religious/ spiritual meetings)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

Sedentary Time – Weekends

On a typical weekend day, how much time do you spend (from when you wake up until you go to bed) doing the following?

23. Sitting while watching TV

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

24. Sitting while using the computer for recreational purposes (i.e., games, Facebook, YouTube, movies, music, Skype, social medial, websites, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

25. Sitting for school (working at the computer, talking on the phone, studying, reading, sitting in lecture or meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

26. Sitting for paid or unpaid (volunteer) work (working at the computer, talking on the phone, office work, reading, sitting in meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

27. Sitting while reading for pleasure

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

28. Sitting while listening to music

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

29. Sitting while playing a music instrument

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

30. Sitting while doing arts and crafts (e.g., scrapbooking, cardmaking, painting, drawing)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

31. Sitting in a motor vehicle in order to get to paid or unpaid (volunteer) work or school (i.e., commuting in a car or sitting in a bus or train)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

32. Sitting in a motor vehicle for leisure-related transportation purposes (i.e., sitting in a car, bus, or train to get to and from recreational activities, visiting friends or family, going out, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

33. Sitting while eating

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

34. Sitting while socializing/ visiting or non-work related phone conversations (e.g., talking with a friend, family member, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

35. Sitting for religious or spiritual pursuits (e.g., meditation, prayer, sitting in church or other religious/ spiritual meetings)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

Leisure Time Exercise Questionnaire

When you think about the last week (7 days), how many times on average would you do the following kinds of exercise for at least 45 minutes during your free time (write in each box the appropriate number)

36. Strenuous Exercise (Heart Beat Rapidly) (i.e. running, jogging, hockey, rugby, soccer, squash, basketball, netball, vigorous swimming, vigorous long distance cycling, roller-blading)

37. Moderate Exercise (Not Exhausting) (i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, cricket, dancing)

38. Mild Exercise (Minimal Effort) (i.e. yoga, archery, bowling, golf, fishing, vacuuming, easy walking)

39. In the last week (7 days), during your leisure-time, how often did you engaged in any regular activity long enough to work up a sweat (heart beats rapidly)? Please tick the answer that best applies to you.

Often

Sometimes

Never/ Rarely

40. Were there any circumstances out of your control that prevented you from engaging in as much physical activity as you had intended to?

Yes

No

If YES, what were they?

Alternative Desk Use Questionnaire

41. Have you ever tried an adjustable standing only desk? i.e.

Yes

No

42. Do you believe adjustable standing only desks should be made available in classrooms for students?

Yes

No

Undecided

43. If you answered yes to question 42: What classroom size do you think adjustable standing only desks would be well suited for? Select all that apply.

Small Class (<16)

Medium Class (16-40)

Large Class (41-100)

Very Large Class (>100)

44. If you answered yes to question 42: Where would you prefer adjustable standing only desks to be located? Select all that apply.

Back rows

Middle rows

Front rows

End of rows

Every row

45. If an adjustable standing only desk were available to use in class, I would use it:

Never throughout the entire course

I would use it for at least one class

I would use it irregularly for some but not all classes

I would use it regularly for some but not all classes

I would use it for all classes during the entire semester

Please explain in your own words why you selected the choice above.

46. If an adjustable standing only desk were available to use while studying, I would use it:

Never while studying

I would use it for at least once while studying

I would use it irregularly for some but not all studying

I would use it regularly for some but not all studying

I would use it for all studying during the entire semester

Please explain in your own words why you selected the choice above.

47. Have you ever tried an adjustable sit-stand desk? i.e.

Yes

No

48. Do you believe adjustable sit-stand desks should be made available in classrooms for students?

Yes

No

Undecided

49. If you answered yes to question 48: What classroom size do you think adjustable sit-stand desks would be well suited for? Select all that apply.

Small Class (<16)

Medium Class (16-40)

Large Class (41-100)

Very Large Class (>100)

50. If you answered yes to question 48: Where would you prefer adjustable sit-stand desks to be located? Select all that apply.

Back rows

Middle rows

Front rows

End of rows

Every row

51. If an adjustable sit-stand desk were available to use in class, I would use it:

Never throughout the entire course

I would use it for at least one class

I would use it irregularly for some but not all classes

I would use it regularly for some but not all classes

I would use it for all classes during the entire semester

Please explain in your own words why you selected the choice above.

52. If an adjustable sit-stand desk were available to use while studying, I would use it:

Never while studying

I would use it for at least once while studying

I would use it irregularly for some but not all studying

I would use it regularly for some but not all studying

I would use it for all studying during the entire semester

Please explain in your own words why you selected the choice above.

53. Have you ever tried a dynamic sitting desk? i.e.

Yes

No

54. Do you believe dynamic sitting desks should be made available in classrooms for students?

Yes

No

Undecided

55. If you answered yes to question 54: What classroom size do you think dynamic sitting desks would be well suited for? Select all that apply.

Small Class (<16)

Medium Class (16-40)

Large Class (41-100)

Very Large Class (>100)

56. If you answered yes to question 54: Where would you prefer dynamic sitting desks to be located? Select all that apply.

Back rows

Middle rows

Front rows

End of rows

Every row

57. If a dynamic sitting desk were available to use in class, I would use it:

Never throughout the entire course

I would use it for at least one class

I would use it irregularly for some but not all classes

I would use it regularly for some but not all classes

I would use it for all classes during the entire semester

Please explain in your own words why you selected the choice above.

58. If a dynamic sitting desk were available to use while studying, I would use it:

Never while studying

I would use it for at least once while studying

I would use it irregularly for some but not all studying

I would use it regularly for some but not all studying

I would use it for all studying during the entire semester

Please explain in your own words why you selected the choice above.

If you would like to be entered into a draw to win 200$ to the Western Book Store please enter your email using the link below. Copy the link below into a new search.

https://www.surveymonkey.com/r/F63NK33

C.2.2 Faculty Survey

Letter of Information

Western

Faculty Sedentary Behavior Survey.

Letter of Information

Introduction

- You are invited to participate in this research study about sedentary behavior and alternative workstations because you are a university faculty greater than 18 years old fluent in English.

Study

- The purpose of this study is to collect information on the sedentary behavior, physical activity, and perceptions of alternative workstations of university faculty.
- Almost all questions are in multiple-choice format. Example questions can be found below:

"On a typical weekday, how much time do you spend (from when you wake up until you go to bed) doing the following? Sitting while watching TV. None, 15 min or less, 30 min, 1 hr, 2 hrs, 3 hrs, 4 hrs, 5 hrs, 6 hrs, 7 hrs, 8 hrs, 9 hours or more"

"Have you ever tried an adjustable standing only desk? Yes, No"

- The survey will take approximately 15 minutes to complete.
- If you agree to this study you will be asked to complete one short survey.
- There are no known or anticipated risks associated with participating in this study.
- You may not directly benefit from participating in this study but information gathered might provide benefits to society as a whole, which include increased use of standing desks in university classrooms decreasing the sedentary time of students.

Right to refuse or withdraw

- The decision to participate in this study is entirely up to you. You may refuse to take part in this study at any time.
- Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time it will have no effect on you.
- You do not waive any legal right by signing this consent form.

Confidentiality

- This study is anonymous. We will not be collecting or retaining any information about your identity.
- The results from this study can be presented and published.
- Representatives of The University of Western Ontario Non-Medical Research Ethics Board may require access to your study-related records to monitor the conduct of the research.

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 my supervisor (Dr. Prapavessis) or me (Siobhan Smith) before, during, or after the research.
- If you have any questions about your rights as a research participant or the conduct of this

Demographic Questionnaire

1. What is your gender?

2. What is your age?

3. What is your weight in kg or lbs?

4. What is your height in cm or inches?

5. Are you a part time or full time faculty member?

Part Time

Full Time

Other (please specify)

6. What rank of professor are you?

Lecturer

Assistant

Associate

Full

Other (please specify)

7. What faculty are you in?

Faculty Arts And Humanities

Richard Ivey School of Business

Certificates and Diplomas

Faculty of Education

Faculty of Engineering

The School of Graduate and Post-Doctoral Studies

Faculty of Health Sciences

Faculty of Information and Media Studies

Inter-Faculty Departments/ Modules/ Programs

Faculty of Law

Schulich School of Medicine & Dentistry

Don Write Faculty of Music

Faculty of Science (including BMSc)

Faculty of Social Science

Other (please specify)

8. What is your ethnicity (i.e. caucasian, hispanic, etc.)?

Sedentary Behavior Questionnaire

Sedentary Time - Weekdays

On a typical weekday, how much time do you spend (from when you wake up until you go to bed) doing the following?

9. Sitting while watching TV

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

10. Sitting while using the computer for recreational purposes (i.e., games, Facebook, YouTube, movies, music, Skype, social media websites, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

11. Sitting for work (working at the computer, talking on the phone, reading, sitting in lecture or meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

12. Sitting for unpaid (volunteer) work (working at the computer, talking on the phone, office work, reading, sitting in meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

13. Sitting while reading for pleasure

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

14. Sitting while listening to music

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

15. Sitting while playing a musical instrument

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

16. Sitting while doing arts and crafts (e.g., scrapbooking, cardmaking, painting, drawing)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

17. Sitting in a motor vehicle in order to get to paid or unpaid (volunteer) work or school (i.e., commuting in a car or sitting in a bus or train)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

18. Sitting in a motor vehicle for leisure-related transportation purposes (i.e., sitting in a car, bus, or train to get to and from recreational activities, visiting friends or family, going out, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

19. Sitting while eating

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

20. Sitting while socializing/ visiting or non-work related phone conversations (e.g., talking with a friend, family member, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

21. Sitting for religious or spiritual pursuits (e.g., meditation, prayer, sitting in church or other religious/ spiritual meetings)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

Sedentary Time - Weekends

On a typical weekend day, how much time do you spend (from when you wake up until you go to bed) doing the following?

22. Sitting while watching TV

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

23. Sitting while using the computer for recreational purposes (i.e., games, Facebook, YouTube, movies, music, Skype, social medial, websites, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

24. Sitting for work (working at the computer, talking on the phone, reading, sitting in lecture or meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

25. Sitting for unpaid (volunteer) work (working at the computer, talking on the phone, office work, reading, sitting in meetings, teleconferences, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

26. Sitting while reading for pleasure

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

27. Sitting while listening to music

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

28. Sitting while playing a musical instrument

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

29. Sitting while doing arts and crafts (e.g., scrapbooking, cardmaking, painting, drawing)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

30. Sitting in a motor vehicle in order to get to paid or unpaid (volunteer) work or school (i.e., commuting in a car or sitting in a bus or train)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

31. Sitting in a motor vehicle for leisure-related transportation purposes (i.e., sitting in a car, bus, or train to get to and from recreational activities, visiting friends or family, going out, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

32. Sitting while eating

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

33. Sitting while socializing/ visiting or non-work related phone conversations (e.g., talking with a friend, family member, etc.)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

34. Sitting for religious or spiritual pursuits (e.g., meditation, prayer, sitting in church or other religious/ spiritual meetings)

None

15 min or less

30 min

1 hr

2 hrs

3 hrs

4 hrs

5 hrs

6 hrs

7 hrs

8 hrs

9 hours or more

Leisure Time Exercise Questionnaire

When you think about the last week (7 days), how many times on average would you do the following kinds of exercise for at least 45 minutes during your free time (write in each box the appropriate number)

35. Strenuous Exercise (Heart Beat Rapidly) (i.e. running, jogging, hockey, rugby, soccer, squash, basketball, netball, vigorous swimming, vigorous long distance cycling, roller-blading)

36. Moderate Exercise (Not Exhausting) (i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, cricket, dancing)

37. Mild Exercise (Minimal Effort) (i.e. yoga, archery, bowling, golf, fishing, vacuuming, easy walking)

38. In the last week (7 days), during your leisure-time, how often did you engaged in any regular activity long enough to work up a sweat (heart beats rapidly)? Please tick the answer that best applies to you.

Often

Sometimes

Never/ Rarely

39. Were there any circumstances out of your control that prevented you from engaging in as much physical activity as you had intended to?

Yes

No

If YES, what were they?

Alternative Desk Use Questionnaire

40. Do you believe adjustable standing only desks should be made available in classrooms for students? i.e.

Yes

No

Undecided

41. If you answered yes to question 40: What classroom size do you think adjustable standing only desks would be well suited for? Select all that apply.

Small Class (<16)

Medium Class (16-40)

Large Class (41-100)

Very Large Class (>100)

42. If you answered yes to question 40: Where would you prefer adjustable standing only desks to be located? Select all that apply.

Back rows

Middle rows

Front rows

End of rows

Every row

43. Do you believe adjustable sit-stand desks should be made available in classrooms for students? i.e.

Yes

No

Undecided

44. If you answered yes to question 43: What classroom size do you think adjustable sit-stand desks would be well suited for? Select all that apply.

Small Class (<16)

Medium Class (16-40)

Large Class (41-100)

Very Large Class (>100)

45. If you answered yes to question 43: Where would you prefer adjustable sit-stand desks to be located? Select all that apply.

Back rows

Middle rows

Front rows

End of rows

Every row

46. Do you believe dynamic sitting desks should be made available in classrooms for students?

Yes

No

Undecided

47. If you answered yes to question 46: What classroom size do you think dynamic sitting desks would be well suited for? Select all that apply.

Small Class (<16)

Medium Class (16-40)

Large Class (41-100)

Very Large Class (>100)

48. If you answered yes to question 46: Where would you prefer adjustable dynamic sitting desks to be located? Select all that apply.

Back rows

Middle rows

Front rows

End of rows

Every row

C.2.3 Quotes

Adjustable Standing Only
Overall Perception
Supportive
"I would love to spend more time standing, but I might not be able to stand during all classes"
"I don't think I could stand for three hours straight. It would be nice to have the option to stand for a little while though."
"I prefer to stand rather than sit but probably wouldn't use it 100% of the time depending how many classes I have that day."
"Maybe once every so often to stretch my legs"
"Most times I don't like sitting, but there are days where I need to sit due to fatigue"
"I would do it to change up sitting all the time"
"I have hip/achilles/foot issues that sometimes prevent me from standing for too long, but sometimes also prevent me from sitting comfortably for too long. I like to have the option to do both."
"I sometimes have trouble standing for long periods of time due to occasional back & knee pain so standing for a 2hr class doesn't seem reasonable but I would utilize it on some occasion because I am always sitting for long periods of time & I know it's not healthy"
"I know sitting is terrible but you aren't given a choice when you sit in lectures"
"I'd prefer the one where you can sit back down"
"I think it's a great idea! We spend so much time sitting to study that it's important to stand at some points - and in class is a perfect time."
"It'd be a nice switch up from the traditional "sitting only desk""
"Because I sit at home while doing school work everyday, and it would be a nice

change to have the increased exercise”

“It's a break from sitting”

“3 hour long lectures, I would switch from sitting to standing half way through to stay concentrated on work in a new setting”

“I always wanted a standing desk but often they are expensive”

“Because I dislike sitting for long periods of time.”

“I like to switch up sitting and standing”

“It would be nice to not sit all the time, but I also think it would be socially awkward to not be sitting when everyone else is”

“Because I am quite the kinesthetic learner I'd need some form of activity to just keep me focused”

“I get very fidgety during long classes, so it would be a nice change from sitting the whole lecture to working at a standing desk.”

“I would use it for most classes, but if I have a lot of classes one day then I would probably sit for one class to rest my legs.”

“I only have class once or twice a week right now and would use it to keep myself from falling asleep.”

“I could see myself standing for portions of every class, as my classes are often 3 hours long. I would likely stand for an hour every class.”

“I feel tired while sitting for 3 hours class so standing desk is good thing”

“Because I do not like to sit during class time, especially for the 1 hour lecture”

“For me, I find standing to be distracting from the lesson when compared to sitting. I do, however, love using a standing desk for just doing work, so I could imagine that for some students they would enjoy standing during lectures.”

“I would try to use it as much as possible but there is so much walking on campus, I would probably want to sit occasionally”

“I feel like there would be a high demand and a low number of standing desks”

“Get tired standing all the time, but nice to stretch legs”

"Its a great way to improve posture, stay focused and prevent sedentary behavior."

"Just to mix things up, give my butt a rest from all the sitting I do all day"

"To sit for back to back lectures is painful, it'd be nice to have the option to stand or sit, provided that I wouldn't be bothering other students."

"I want a standing desk for myself at home so I would love to have it in classes."

"I would use it to take breaks from sitting"

"Whether or not I would use it depends on how many desks are available - if there is only 1, I would likely not use it, but if there are many, I may use it if it is available."

"It would be a nice change from sitting down all the time"

"I dislike sitting for long periods of time, however in certain classes, and for testing situations, sitting would be preferred"

"I would most likely get tired from standing so frequently so I would take some days to sit instead of stand."

"I may want to sit down at certain times"

"Sometimes you've been sitting all day and it's nice to stand up. You also have better focus while standing. Long classes (3h lectures) can be exhausting to sit in and standing can keep me engaged."

"Standing the entire time is equally as bad as sitting all the time"

"Standing>Sitting"

"I Chose irregularly because I get tried walking to and from home/school so I'd like to be able to sit sometimes."

"Hard to break habit of sitting but might gradually start standing more."

"Especially at the start, wouldn't be able to stand during back-to-back classes because I'm just not accustomed to it. Would progress from every other class to perhaps every class."

"Its sounds fun"

"Certain classes are so long I have trouble sitting for the whole period of time"

"When I had an adjustable desk in the past, I found myself switching back and forth

between sitting and standing as it was comfortable, and therefore would likely use it daily, however not for the entire duration of every lecture"

"I see the merit as to why some people would want to use it. I just feel I workout enough already I wouldn't need to stand to feel as though I'm getting an extra "workout" in. But I feel the value for others who may not have the time or luxury of going to the gym frequently."

"Keeps me on my toes"

"Sitting in long lectures can make me tired causing me to lose focus"

"I think it is good to stand sometimes rather than seating all the time. This might save me from some back pain related issues."

"I would like to alternate between sitting and standing"

"I enjoy spending less time sedentary"

"I believe I need to sit less but I get sore feet standing for too long."

Undecided

"I would use it just to try it out, but during a lecture I think I would prefer to sit"

"To try it out"

"I would have to try it out to decide how often I would use one in class"

"I've never tried it - so I would definitely have to try it at least once and see how I feel about it."

"I would want to try the standing desk to see if I enjoyed using it or if it helped me focus."

"I would try it and see"

"I have never used one before so I do not know how they feel. I think I like the idea, but because I have never used one I am not sure how comfortable it would be. Nor if I would stay as focused. Time of class and length would be a factor in my decision."

"I would at least try it out to see if I preferred it"

"I'd be curious to try it, and sometimes I get tired of sitting"

"I would want to try it out at least once and see what it's like but sitting in class is usually more comfortable."

"Curiosity but school is already exhausting enough"

"I would try it at least once to see how I felt about it."

"Try it but would find it hard to focus on class"

"I'll try it out but most likely won't like it... I would never stop in the middle of the class just to adjust my desk (disrupting). If I am standing at the desk, looks like I'd be standing for the entire class, but why would I want to stand for class???? I don't."

"To try it out at least, but I don't think I would focus enough"

"I would try it but I don't think I would enjoy it"

"Curious to try it"

"Try it out to see if I like it"

"Ill try anything once!"

"I would test it out to see how it works and how it changes regular study habits. I have never used one so I don't know how I would like it"

"I would try it once"

"Getting used to standing would take time. Willing to try!"

"All of my classes are 3 hours long and standing for one class would be too much so I would maybe try it once a week, every other week."

"Trying a new way to have lesson"

"Try it out"

"I might have to get used to it, its hard to know for sure"

"I would like to try it out but I assume it will be tiring to stand in one spot for an hour"

"Not sure how I feel about them or if I'd like it"

"To see if I like it better than sitting or not"

"I would want to try it first." "I would have to try it to know if it would affect my class performance" "It depends on the class and the time that a person is required to stand. Some lectures are 3 hours long and it's unreasonable to expect someone to stay up for such an extended period of time. If there were adjustable standing desks, they should be sparing and be for people who occasionally want to take a break from sitting. I would try it but never use it all the time." "I have never used one and would try it out but would only continue to do so if they were being used by others. It is more functional for a study space than a lecture" "I would at least want to try it." "Never tried it but I'd be willing to give it a try" "I might try it out, but have no clue whether I'd make a regular habit of it or not" "I may try it depending on the class but would not commit one way or the other" "I've never tried it. If it works, I'd use it more often" "Would have to try first to see benefits" "Because I'm not sure how I feel about them"
Opposed
"I would use it just to try it out, but during a lecture I think I would prefer to sit" "Seems uncomfortable and tiring to stand for 1-3 hour lecture" "Too used to sitting down at a proper desk. Frequent back pains would prevent me from standing up for long periods of time." "It seems tiring" "I would want to try it out at least once and see what it's like but sitting in class is usually more comfortable." "I feel that personally I am not overly sedentary and so a standing desk is less necessary, and it would be more comfortable to sit."

"I'm in a wheelchair"

"In class I need to focus and sit to write notes properly; also it's not as comfortable"

"Not practical"

"Tiring"

"It's tiring to stand for long periods of time."

"I would never want to stand while in class."

"Standing still for long periods of time would make me restless. I would prefer to be sitting or moving"

"I prefer to sit down when working, and personally feel that standing would cause me to be distracted."

"I prefer sitting down because I have knee issues"

"I would get uncomfortable"

"Why stand when I can sit?"

"I do not like them"

"There is too much walking involved for me to get to classes so I would prefer to sit while in class."

"I prefer to sit"

"I think I might get tired"

"I would prefer to sit rather than to stand in general."

"I hate standing still. I would be open to bouncy balls as seats or something to keep moving, but I would absolutely hate standing"

"I'll try it out but most likely won't like it... I would never stop in the middle of the class just to adjust my desk (disrupting). If I am standing at the desk, looks like I'd be standing for the entire class, but why would I want to stand for class???? I don't."

"Prefer to sit down. But may use it to keep self from falling asleep."

"I'd never want to be standing so it would be wasted on me"

"It does not interest me as I prefer to sit down"

"I don't think standing still in one spot is advantageous for long periods of time"

"Don't like standing"

"Prefer to sit"

"My classes are long and spread throughout the day with so much work and I'm always tired."

"I am tired all of the time so I do not like standing for extended time periods"

"Too lazy to stand"

"I'm lazy and would prefer to sit"

"I'm a sitter"

"I feel I would get tired standing up"

"I prefer sitting as it makes my back feel better"

"Seems unnecessary"

"Sometimes you just need to have a good sit"

"I prefer sitting while taking notes"

"Tiring"

"State of body whether sitting or standing should not impact your performance, it is how passionate you are about your work. So, standing desks are useless."

"I think ill get tired"

"I am generally very tired and trying very hard to concentrate on just one thing while in class"

"It's more distracting to have to stand up while listening to a professor lecture and ultimately sitting is more comfortable"

"I believe I may be uncomfortable."

"I prefer to sit while I am working. I find that sitting is more relaxing than standing

and I am better able to concentrate on the course material when I am in a relaxed state of mind."
"I usually had a max of 3 hours of class (including break) in a day so I just don't think I would need it"
"Sitting is more comfortable"
"During class I prefer to sit down since I feel more comfortable and can focus better"
"Can't stand long"
"I have to stand at work, I'd rather sit to listen to a lecture"
"I work in a lab where I am standing all the time already"
"Standing and listening to a professor talk for an hour can become very tiring. Especially since all of my classes are 2 to 3 hours long."
"I'm a cashier, so I already spend enough time standing until my feet hurt."
"I see the merit as to why some people would want to use it. I just feel I workout enough already I wouldn't need to stand to feel as though I'm getting an extra "workout" in. But I feel the value for others who may not have the time or luxury of going to the gym frequently."
"Too hard to stand"
Personal Factors
Health/ Injury
Facilitator
"Health benefits, sitting hurts my back"
"I recognize that I have an unhealthy diet and work regimen and this is a slight way to counter it using minimal effort"
"It is healthier to use the standing desk, so I would want to use it as much as possible, but there would probably be some days where I'm too tired to use it and just need to sit."

"It's better for your back." "My back hurts when I sit and I hate how low my blood flow gets, making it difficult to get up and run to the bus after a class" "I'm lazy but understand the importance of trying to live a less sedentary lifestyle" "It's a great way to improve posture, stay focused and prevent sedentary behavior." "Sitting for too long is not good for your health" "Due to a bulging disk, it is better for my back to avoid a seated position for extended periods." "I know standing is better for you, and I always use a notebook in class. The desk facilitates both my good health and note taking." "Improve health" "I love standing only desks as they help me to stay alert and help relieve pressure from sitting for long periods." "Because my sitting for a long time makes my butt cramp up" "I think it is good to stand sometimes rather than seating all the time. This might save me from some back pain related issues." "I have had posture and back problems that required consulting a physiotherapist"
Barrier
"Being on my feet too long causes back problems" "Too used to sitting down at a proper desk. Frequent back pains would prevent me from standing up for long periods of time." "I am a dancer and some days I have bad knee pain so wouldn't want to stand all the time for long classes" "I wouldn't be able to stand for longer than an our at a time, wouldn't want to develop varicose veins" "I have hip/achilles/foot issues that sometimes prevent me from standing for too long,

but sometimes also prevent me from sitting comfortably for too long. I like to have the option to do both."

"I sometimes have trouble standing for long periods of time due to occasional back & knee pain so standing for a 2hr class doesn't seem reasonable but I would utilize it on some occasion because I am always sitting for long periods of time & I know it's not healthy"

"I have back problems, so standing for long periods of time can be painful"

"I feel like always standing for every class would become tiring and lead to sore legs"

"I suffer from scoliosis."

"I prefer sitting down because I have knee issues"

"Walking is one thing, but standing still for a long period of time causes me to have lower back pain"

"I have really bad joint pain in my knees"

"I feel that I am so used to sitting down for class that standing up and listening would make me anxious."

"Feet get tired and uncomfortable to write"

"It's bad on your feet"

"Standing for long periods of times hurt my knees"

"While I have knee and hip issues from sports injuries, I find that regular use of a standing desk does not help these issues"

"I am a nursing student, for nursing I spend 13 hours on my feet at a time. Because of that, on the days when I am not in nursing I like having the option to sit down"

"My back would hurt. I need to sit to feel comfortable in order to take notes during class."

"It would be really hard to stand for a 3-hour lecture, especially when you have a foot condition (i.e. flat feet)"

"I tend to get a sore back to previous injury, Standing for extended periods of time tend to aggravate the injury"

"Some classes are 3 hours long, standing for 3 hours long can trigger back pains."

"I believe I need to sit less but I get sore feet standing for too long."
Classroom Performance
Facilitator
"Some classes are easier to fall asleep in, standing would help stay awake. Standing while speaking in class (for courses with discussions) also makes speaking more enthusiastic" "When feeling tired (standing keeps me alert)" "3 hour long lectures, I would switch from sitting to standing half way through to stay concentrated on work in a new setting" "Prefer to sit down. But may use it to keep self from falling asleep." "Because I am quite the kinesthetic learner I'd need some form of activity to just keep me focused" "Depending on the course, time of day, level of exhaustion. I would like to stand more to keep me more awake and alert when the class permits it." "Depends on the class and for some classes to change it up for variety to keep me engaged" "Because I heard you remember more when standing." "I only have class once or twice a week right now and would use it to keep myself from falling asleep." "It's a great way to improve posture, stay focused and prevent sedentary behavior." "Would use it for the classes that tend to put me to sleep to help me stay awake" "Sometimes you've been sitting all day and it's nice to stand up. You also have better focus while standing. Long classes (3h lectures) can be exhausting to sit in and standing can keep me engaged." "I know standing is better for you, and I always use a notebook in class. The desk facilitates both my good health and note taking."

"I get fidgety during class and standing would help with that" "It would be good to use on days when you are really tired and unfocused! It would definitely help to stay awake and stay focused" "I love standing only desks as they help me to stay alert and help relieve pressure from sitting for long periods." "It keeps me more alert throughout the class, less tendency to drift off, and reduces time sitting (as it presumably would not be available in every class)." "Sitting in long lectures can make me tired causing me to lose focus"
Barrier
"I could see it being sometimes hard to take notes at" "Too tired and exhausted from standing in the mornings, also I'm really shifty so it would cause me to lose focus on class" "In class I need to focus and sit to write notes properly; also it's not as comfortable" "In my three hour lectures, I would become more focused on how much longer I have to stand than the actual course material. My one hour lectures go by so fast, I wouldn't have time to focus on anything else" "I would be more prone to fidgeting/shifting (which I do while standing) and I would likely want to sit down often, and shift a lot from standing to sitting. This might be because I'm out of shape though." "I prefer to sit down when working, and personally feel that standing would cause me to be distracted." "Try it but would find it hard to focus on class" "I would worry it would be distracting to other students" "To try it out at least, but I don't think I would focus enough" "For me, I find standing to be distracting from the lesson when compared to sitting. I do, however, love using a standing desk for just doing work, so I could imagine that for some students they would enjoy standing during lectures." "Tiring, I feel I would be more fidgety and unfocused if I were standing and trying to

listen to a lecture” “Because it's harder to type.” “I need to sit down in order to focus and think. I'd use it if I arrived late and there were no spots” “It would be distracting to adjust the desk while in class” “It would be harder to concentrate. Classes are too long to stand only.” “It's more distracting to have to stand up while listening to a professor lecture and ultimately sitting is more comfortable” “I prefer to sit while I am working. I find that sitting is more relaxing than standing and I am better able to concentrate on the course material when I am in a relaxed state of mind.” “I find it hard to concentrate when the body is not fully relaxed” “I'd find it more difficult to concentrate.” “I think I would get tired in the longer lectures, loose focus, and not take as good notes” “I would move around and fidget too much at a stand up desk” “During class I prefer to sit down since I feel more comfortable and can focus better” “Easier to focus and write while sitting” “My back would hurt. I need to sit to feel comfortable in order to take notes during class.”
Social/ Environmental Factors
Depends on the day
“Too tired and exhausted from standing in the mornings, also I'm really shifty so it would cause me to lose focus on class” “Most times I don't like sitting, but there are days where I need to sit due to fatigue”

"It would be depended on the shoes I was wearing and how many people were sitting behind me."

"I'd use it if I had a high energy level or my back was hurting"

"It's more of a feeling to sit or not Andy how long have sat earlier in the day."

"Depends how I tired I was"

"Usually I prefer to stand while learning, but some days if I had to walk to class/run to catch the bus I'd just want to crash and sit down during lecture"

"Depends on how tired I am or if my legs/feet hurt, I would want the option to be able to sit or stand."

"Depends on what day is busier and if it's after practice then I wouldn't because I'm usually tired for class after practice"

"Some days I may be tired and would rather be able to sit down for a 2 hour lecture"

"It is healthier to use the standing desk, so I would want to use it as much as possible, but there would probably be some days where I'm too tired to use it and just need to sit."

"I would choose to use it if I were unable to fit in a workout on that day"

"Depending on the course, time of day, level of exhaustion. I would like to stand more to keep me more awake and alert when the class permits it."

"Some days I'm more restless then others so I'd want to stand. As well I wouldn't want to use it for my math class."

"Depends on how I feel that day"

"Depending on how tired I am"

"I would try to use it as much as possible but there is so much walking on campus, I would probably want to sit occasionally"

"Could get tiring over the course of the day"

"Depends on feel"

"Depending on whether the desks are available and how I'm feeling that day (ex. tired, energetic, etc.)"

"I get tired of standing sometimes"

"My usage would depend on my health condition of the day"

"Sometimes I feel like I need to sit, so I wouldn't always want to be standing"

"If I've had to speed walk 20 minutes across campus to class I probably wouldn't use it that day; if I've only walked a little ways to class and otherwise had a lazy day, I would probably use it."

"All classes would get tiring, but irregularly because some days I feel more tired than others."

"Could depend on how I was feeling that day"

"Sometimes you have long days, and ideally after a long day you might not want to stand in class. But I would try my best to use it as much as possible."

"All classes but use would vary by class/day"

"Some days you may be more tired than others, it is also a lengthy period of time to be standing (especially if the class is longer than an hour)"

"I could possibly get tired"

"I would most likely get tired from standing so frequently so I would take some days to sit instead of stand."

"Depends on how much energy I have and how much writing I would have to do"

"I chose irregularly because I get tried walking to and from home/school so I'd like to be able to sit sometimes."

"It would be good to use on days when you are really tired and unfocused! It would definitely help to stay awake and stay focused"

"It depends on my energy level going into the class. If it's a morning class and I'm feeling sleepy, I would be less inclined to use the standing only desk."

"I would most likely use it less in the morning when I'm tired. However more in the afternoon after sitting for 1 or 2 classes"

"It depends how tired I am that day"

"When I was in undergrad I was really tired during class so normally would nap lol"

Depends on the location/ availability
"It would be depended on the shoes I was wearing and how many people were sitting behind me."
"Depends on location of desk relative to screens, outlets, doors, etc. takes time to adjust to correct height"
"It would depend on how common it was for people to use them and if I felt like I was blocking anybody"
"Wouldn't want to draw attention to myself, I also have a hard time seeing and I think these desks would have to be at the back"
"Does not seem practical to be standing up while typing out lecture notes as if everyone in the class were to do so, someone with my height may not be able to see the board if there is someone taller in front of me."
"Have to pay attention to prof and wouldn't be able to see"
"Some classes are too long, or if its a big class I might not be able to see over the person in front because I am short"
"I am short and if there are people in front of me who are tall, I won't be able to see and it would be bothersome. Also, standing up for 1-3 hours is going to hurt my legs."
"If I'm too short to see over the other people in front of me, I wouldn't be able to use the desk while viewing the lecturer."
"I feel like there would be a high demand and a low number of standing desks"
"Depending on whether the desks are available and how I'm feeling that day (ex. tired, energetic, etc.)"
"Whether or not I would use it depends on how many desks are available - if there is only 1, I would likely not use it, but if there are many, I may use it if it is available."
"Depending on location of standing desks, you run the risk of being an obstruction of view for other students"
Depends on the social norm

"It would depend on how common it was for people to use them and if I felt like I was blocking anybody"

"Wouldn't want to draw attention to myself, I also have a hard time seeing and I think these desks would have to be at the back"

"Would feel weird unless others used it"

"Would likely only use it if others were as well"

"It would be nice to not sit all the time, but I also think it would be socially awkward to not be sitting when everyone else is"

"It's a new concept, there would be some social pressure to not use it, so I'd probably only use it for one class"

"Because I want to sit in a chair and write notes like everyone else lol"

"I believe that I wouldn't be able to get used to standing at a desk, after going to school and taking classes sitting down for so long. Furthermore, for certain lectures that are longer (2+ hours), my legs would tire."

"Unless it was standardized (i.e. being the only desk in the classroom) I would be much less likely to use it as I would feel uncomfortable"

"It would be somewhat awkward because most students have other students that they tend to sit with. Using a standing desk during class would be an act of intentionally removing oneself from one's group"

"It would be embarrassing when no one else used one"

"Whether or not I would use it depends on how many desks are available - if there is only 1, I would likely not use it, but if there are many, I may use it if it is available."

"Might be awkward if not everyone is standing"

"Hard to break habit of sitting but might gradually start standing more."

"I have never used one and would try it out but would only continue to do so if they were being used by others. It is more functional for a study space than a lecture"

"It's weird unless everyone else is also using it."

"I feel like when adjustable standing desks start being a thing, it won't be very common and I don't want to be judged for using one."

Depends on the class type/ time/ task
"I'd use it only if necessary for writing."
"I could see it being sometimes hard to take notes at"
"There are some classes where I would prefer to sit (i.e., discussion-based classes, or classes that take place early in the morning when I am tired)."
"Does not seem practical to be standing up while typing out lecture notes as if everyone in the class were to do so, someone with my height may not be able to see the board if there is someone taller in front of me."
"Writing (paper, pencil) tends to be easier sitting, for some classes which require lots of note taking, I may sit."
"Don't want to stand for a 3h lecture or one that I need to pay close attention to"
"Depending on the course, time of day, level of exhaustion. I would like to stand more to keep me more awake and alert when the class permits it."
"Some courses require writing which needs sitting down"
"Depends on the class and for some classes to change it up for variety to keep me engaged
"Some days I'm more restless then others so I'd want to stand. As well I wouldn't want to use it for my math class."
"Depends on the time of day the class is"
"Some classes require more typing which may be harder in a standing desk"
"For me, I find standing to be distracting from the lesson when compared to sitting. I do, however, love using a standing desk for just doing work, so I could imagine that for some students they would enjoy standing during lectures."
"Depends on how face paced the class is, what time the class is, the amount of people in the class"
"Depends on how much writing or typing I have to do"
"Feet get tired and uncomfortable to write"

"Some classes require faster writing and more intense focus, that standing desks would not be appropriate to write notes on"
"Would use it for the classes that tend to put me to sleep to help me stay awake"
"I dislike sitting for long periods of time, however in certain classes, and for testing situations, sitting would be preferred"
"Depends on how much energy I have and how much writing I would have to do"
"Depending on the time of day I have the class and what day, as I am sometimes coming from the gym and would like to sit."
"I have one class, the rest is research, I would use a standing desk to do research work on computer"
"The professor gives individuals a chance to stand every hour - no need to stand the whole time."
"I may try it depending on the class but would not commit one way or the other"
"It depends on my energy level going into the class. If it's a morning class and I'm feeling sleepy, I would be less inclined to use the standing only desk."
"I would most likely use it less in the morning when I'm tired. However more in the afternoon after sitting for 1 or 2 classes"
"I prefer to focus on writing and listening"
Depends on the length/ number of classes
"I would love to spend more time standing, but I might not be able to stand during all classes"
"Seems uncomfortable and tiring to stand for 1-3 hour lecture"
"I don't think I could stand for three hours straight. It would be nice to have the option to stand for a little while though."
"Too used to sitting down at a proper desk. Frequent back pains would prevent me from standing up for long periods of time."
"Would depend on how long the class is"

"I prefer to stand rather than sit but probably wouldn't use it 100% of the time depending how many classes I have that day."

"I am a dancer and some days I have bad knee pain so wouldn't want to stand all the time for long classes"

"I do not think that I would use it for long classes."

"I would not want to stand all day"

"I wouldn't be able to stand for longer than an our at a time, wouldn't want to develop varicose veins"

"My feet might get sore in long lectures."

"I have never used one before so I do not know how they feel. I think I like the idea, but because I have never used one I am not sure how comfortable it would be. Nor if I would stay as focused. Time of class and length would be a factor in my decision."

"Duration of lecture"

"All my classes are 3 hours in length and I would not want to stand for the entire time"

"I sometimes have trouble standing for long periods of time due to occasional back & knee pain so standing for a 2hr class doesn't seem reasonable but I would utilize it on some occasion because I am always sitting for long periods of time & I know it's not healthy"

"I would use it sometimes, but for classes that are over 2 hours there is no way I am going to stand for 2 hours or more"

"I would use it for my shorter lectures (one hour), but not for longer ones."

"I feel like always standing for every class would become tiring and lead to sore legs"

"Shorter classes I would use it but not for a 3 hour lecture."

"In my three hour lectures, I would become more focused on how much longer I have to stand than the actual course material. My one hour lectures go by so fast, I wouldn't have time to focus on anything else"

"If I have back to back classes I may want to sit during some classes but I would try to stand most of the time"

"If my lectures were 50 minutes long only"

"Having multiple back to back classes, it could get tiring from standing all day."

"Some of my classes are long and it would probably not be comfortable to stand for 3 hours straight."

"3 hour long lectures, I would switch from sitting to standing half way through to stay concentrated on work in a new setting"

"I wouldn't want to stand for that long"

"Don't want to stand for a 3h lecture or one that I need to pay close attention to"

"The class is very long so I would need to sit"

"I would use it for classes <2 hours, not for 3 hour lectures"

"Use it for the shorter lectures"

"I don't think standing still in one spot is advantageous for long periods of time"

"I would use it for most classes, but if I have a lot of classes one day then I would probably sit for one class to rest my legs."

"I could see myself standing for portions of every class, as my classes are often 3 hours long. I would likely stand for an hour every class."

"Some classes are just to long to stand for the whole entire period"

"Some classes are too long, or if its a big class I might not be able to see over the person in front because I am short"

"For the classes for which I have long lectures (1 and a half hours+) I believe that my legs would become stiff and painful from standing still for so long."

"Most of my classes are the 3 full hours and standing that long while only listening and typing is much harder than if I could sit for a portion and do the same"

"It's not the most comfortable after a while."

"I am short and if there are people in front of me who are tall, I won't be able to see and it would be bothersome. Also, standing up for 1-3 hours is going to hurt my legs."

"Depending on the length of the class, I wouldn't want to stand for long periods"

"I would probably use a standing desk for classes that are 1-2 hours long but not 3."

"My classes are all 50 minutes, which is a reasonable time to stand, but after several in a row, and especially after a workout, it is difficult to remain standing"

"3 hour classes would be a long time to stand in one place"

"It depends on how long the class is. If it's 3 hours I'm not going to use one, but if the class is 1 hr-1 1/2 then I may consider it"

"Standing for long periods of times hurt my knees"

"I believe that I wouldn't be able to get used to standing at a desk, after going to school and taking classes sitting down for so long. Furthermore, for certain lectures that are longer (2+ hours), my legs would tire."

"I would wish to change position to a standing desk part way through a given lecture, but likely not for all lectures."

"Sometimes I feel like I need to sit, so I wouldn't always want to be standing"

"Some lectures are too long to stand for - 3 hours standing in the same spot would cause my feet and shoulders to get sore. I would use it for the hour long lectures"

"To stand for entire 3 hour lecture that is not engaging would be draining"

"All of my classes are 3 hours long and standing for one class would be too much so I would maybe try it once a week, every other week."

"Depends on the length of the class"

"It would be harder to concentrate. Classes are too long to stand only."

"Some days you may be more tired than others, it is also a lengthy period of time to be standing (especially if the class is longer than an hour)"

"Most of my classes are two hours, so I wouldn't want to be standing the whole time. Maybe only part of the class."

"It would be tiring to stand all the time"

"I feel like I would get tired standing for the whole lecture period"

"I think I would get tired in the longer lectures, loose focus, and not take as good notes"

"Depends if the class was short enough for you to stand the whole time. If the class

was too long, I'd want to sit down at some point."

"It depends on the class and the time that a person is required to stand. Some lectures are 3 hours long and it's unreasonable to expect someone to stay up for such an extended period of time. If there were adjustable standing desks, they should be sparing and be for people who occasionally want to take a break from sitting. I would try it but never use it all the time."

"Depending on the number of classes that day, I would take the opportunity in one class to sit"

"I would only use it for my 1 hour classes but sit for my 3 hour classes"

"Depends on class length"

"It would be really hard to stand for a 3-hour lecture, especially when you have a foot condition (i.e. flat feet)"

"Certain classes are so long I have trouble sitting for the whole period of time"

"I might get sick of standing during long lectures"

"Most lectures are too long for me to remain standing"

"When I had an adjustable desk in the past, I found myself switching back and forth between sitting and standing as it was comfortable, and therefore would likely use it daily, however not for the entire duration of every lecture"

"I tend to get a sore back to previous injury, Standing for extended periods of time tend to aggravate the injury"

"Some lectures are 3 consecutive hours and I will need to sit down to rest"

"Some classes are 3 hours long, standing for 3 hours long can trigger back pains."

"I would eventually like to take a seat"

<u>Adjustable Sit-Stand</u>

Overall Perception

Supportive

"I love the fact that I can sit when I'm tired standing"

"Some lectures are so long/boring need to be available to pay attention"

"I love how it gives both sitting and standing options. Would try it once to see if I like it"

"I like the option of being able to stand during class."

"I would be more likely to use this because you could take breaks as you needed & sit for things you prefer to do sitting"

"This type of desk would be perfect since it allows for both options."

"I can choose to stand if I want, but I can also sit if I'm tired; I wouldn't use it for some classes, since the sit-stand desks are at the back and I usually prefer to be up at the front for some classes to take notes"

"I would use it more often as it is adjustable."

"It's the equivalent of a regular desk except you have the option to stand up and when you are tired of sitting or sit back down when you are tired of standing"

"There's a chair I can use when I get tired"

"Because you can alternate"

"It's good to have options, depending on how sedentary the day is"

"The adjusting would be distracting so I would pick a seat if I wanted to sit at some point"

"I would do it to change up sitting all the time"

"If I can choose to sit or stand I would probably use it more because some days I may feel like I've been sitting too much but others maybe not and id rather sit."

"You can choose to sit or stand, I'd want the option"

"I have the option so once in a while I could stand up to stay more focused and stretch"

"Because I could decide to sit if I was tired or sore"

"You can choose the setting that works for you"

"Depends on how tired I am or if my legs/feet hurt, I would want the option to be able to sit or stand."

"For longer lectures I could go from standing to sitting"

"I would use it more often then the stand only desk because it gives you the option of sitting down. Having back to back classes, it could get tiring/painful to be on your feet all day, at least when first starting to stand in class."

"This allows you the choice to switch between sitting and standing which can ease restlessness, however I may feel embarrassed to make noise when switching"

"Again, a nice switch up. Also it'd give my bum a rest for the long lectures"

"You can choose whether to sit or stand depending on how you feel that day"

"It would be easy to decide that day whether I wanted to sit or stand. I could make the decision based on how tired I was feeling."

"Increased exercise, but also the ability to sit if need be."

"I would use it regularly because it gives me the option to choose"

"Gives the option to sit or stand"

"Flexibility in sit/stand depending on mood etc."

"It depends the length of the class, but it would be good to stand and sit in the middle of classes to not get too tired from sitting"

"Easy to change"

"I can still sit"

"I like to switch up sitting and standing"

"It would be nice to not sit all the time, but I also think it would be socially awkward to not be sitting when everyone else is"

"I'd use it more often because of the versatility it offers."

"They're adjustable and given the opportunity to use them, so long as they're comfortable to use, they offer the best option"

"It's the perfect solution as it allows both sitting and standing to change position and keep focus"

"Sometimes it'd be good to be able to adjust the height of the table"

"I would use it for most classes, but if I have a lot of classes one day then I would probably sit for one class to rest my legs."

"Again, if provided the opportunity would use it every class for portions of the class, but not the whole time."

"I like the option to stand sometimes but sit if I feel like it. The current desks hurt my back"

"Since I would be able to adjust it there would be no concern about having to stand for uncomfortable periods of time, and therefore I would use it more often."

"Because I do not like to sit during class time, especially for the 1 hour lecture"

"I think it gives students the ability to chose whether to stand or sit and what position to have the desk in"

"Can pick whether or not I'd want to stand; depends on the class"

"This is perfect and I didn't know this was a thing. I would totally use this over the standing desk because when I am tired I could transition into a sit desk"

"It would be an interesting experience and a good balance of sitting and standing."

"Great idea."

"I would only use it if willing and not tired"

"I like the freedom to choose to sit or stand"

"If it was adjustable, I would be about to sit or stand depending on what I felt like doing"

"There is options for both"

"Because I have the option to sit down if I do not enjoy it."

"Can change back in forth depending on what you're feeling"

"I would be able to stand/sit when I pleased which is good for when my legs get tired"

"Gives option of sitting and standing so helps back"

"Option of stand or sit."

"Just to mix things up, give my butt a rest from all the sitting I do all day"

"I would appreciate the option to stand occasionally"

"If I had the option to sit when I wanted to, then I would probably use it all the time. Sometimes standing is too much, you don't feel well, it's been a long day, etc."

"If it's adjustable, I could adjust the desk so I can use it while standing up which would be a nice change during lectures since my lectures are very long. I could also re-adjust the height of the desk back down to sitting height when I get tired of standing."

"To adjust the height of the table depending on everyone's needs."

"Better to have the option to adjust the desk whenever you want"

"I feel like this would provide me the ability to change positions in order to help me concentrate"

"This way you can sit or stand as you want"

"More versatile in terms of choice so I would use it more often"

"I would like the option to sit and stand when I want"

"I may want to sit down at certain times"

"When I am experiencing pains from exercise or am feeling ill the sitting feature would be helpful"

"A sit-stand desk makes it easy to change between sitting and standing which is convenient for adjusting your position based on your mood/energy level"

"I would be able to stand and sit as much as I wanted"

"Because I can choose whether I sit or stand"

"Personal preference"

"If ever I do want to stand, I have the option to do so"

"I chose regularly for most classes because I like the option it gives me- so if I'm tired

at the beginning of class it can be a sit- but if my legs get restless I could make it a stand."

"Some classes are really long, and thus would require a change (from sitting to standing, for example)."

"I would enjoy having the option of being able to stand up and let my body stretch after sitting for long periods of time. When I sit or stand depends on the day and how I am feeling."

"It's convenient. I would not have to move to a different desk to either sit or stand"

"I like the customizable option if there is ever a need for a change in comfort in the middle of a lecture for example."

"It seems cool, I would give it a shot if I got angsty and needed to move around during class."

"I would use it regularly, but having the option to sit down may make it difficult to resist the urge to sit."

"Seems like they would be more comfortable than just a standing desk"

"I would prefer to reduce sedentary time as much as possible, however for days when fatigued from workouts I would prefer to sit occasionally so the adjustable sit-stand desk would be ideal"

"I would use this more than the standing adjustable desk. It still gives you the option for sitting but you can stretch your legs and stand if you feel necessary. More flexibility with this option."

"Need to stretch"

"I could choose if I wanted to sit or stand depending on how tired I get throughout lectures"

"It's nice to be given the option to either sit or stand during class"

"Allows me to sit and stand but would not use at all times"

"This lets me stand when I want and provides a solution to my sore feet problem."

"3 hour long lectures, I would switch from sitting to standing half way through to stay concentrated on work in a new setting"

"I always wanted a standing desk but often they are expensive"

"I get very fidgety during long classes, so it would be a nice change from sitting the whole lecture to working at a standing desk." "It's a great way to improve posture, stay focused and prevent sedentary behavior." "It would be a nice change from sitting down all the time" "Hard to break habit of sitting but might gradually start standing more." "When I had an adjustable desk in the past, I found myself switching back and forth between sitting and standing as it was comfortable, and therefore would likely use it daily, however not for the entire duration of every lecture" "It keeps me more alert throughout the class, less tendency to drift off, and reduces time sitting (as it presumably would not be available in every class)."
Undecided
"I love how it gives both sitting and standing options. Would try it once to see if I like it" "I would at least try it out to see if I preferred it" "I would like to test it out but I'm not sure how much dedicated use it would take to contribute towards my goals" "Again curiosity" "I would like to try it, and see what it is like." "I'd want to try it out incase I was uncomfortable sitting for 3 hours straight." "I'd try it but would hate the distraction of people altering the desks" "Would try it but not make it a habit, since id probably get tired and distract others" "I would give it a try and see how I am feeling each day" "I would like to try it but not for every class" "Curious to try" "Try it"

“Try anything once”
“To try it to see if it's something that I like or not.”
“I would want to try it out”
“Would be interesting to try but I don't want to stand all the time”
“To try”
“Just to try it.”
“I would try it”
“Try it”
“Nice choice for a try”
“Try it out”
“Just to try it once”
“Again, I would have to try it. If I didn't enjoy standing, I assume you could still sit down for the rest of the course/lecture”
“I have never used one and would try it out but would only continue to do so if they were being used by others. It is more functional for a study space than a lecture”
“I would at least want to try it.”
“If it works, I'd use it more often”
“Try it out”
“Not sure”
“Don't know as much”
“I've never tried it - so I would definitely have to try it at least once and see how I feel about it.”
“I might try it out, but have no clue whether I'd make a regular habit of it or not”
Opposed

"I like sitting"
"Seems impractical"
"I prefer to sit during lectures"
"I prefer to sit during lecture"
"I'm in a wheelchair"
"Tiring"
"I like sitting at the front"
"Why stand when I can sit?"
"I would use the sit only"
"Too much walking to my classes, so I would not use it"
"I prefer to sit"
"I most likely will not be standing while in class."
"Probably not, because the desks would be adjusted at different heights where a short the person (like myself) won't be able to reach, and I hate the inconvenience of having to readjust the height before I take seat for class."
"It seems unnecessary"
"Too lazy to stand"
"I would favor sitting over standing"
"I believe that I wouldn't be able to get used to standing at a desk, after going to school and taking classes sitting down for so long. Furthermore, for certain lectures that are longer (2+ hours), my legs would tire."
"It seem unnecessary"
"See no point in using it myself over a traditional desk"
"Would probably sit"

"Useless and very stupid, it would hinder learning and distract people." "I prefer to sit while I am working. I find that sitting is more relaxing than standing and I am better able to concentrate on the course material when I am in a relaxed state of mind." "Can be disruptive during class, block view for other students, and I'm more comfortable sitting" "This seems like a waste for a class" "I'm a cashier, so I already spend enough time standing until my feet hurt."
Personal Factors
Health/ Injury
Facilitator
"Health benefits" "I like the option to stand sometimes but sit if I feel like it. The current desks hurt my back" "Gives option of sitting and standing so helps back" "Being able to engage the body, even momentarily, breaks up the monotony and reduces pain." "I could maintain a 1:1 ratio of standing/sitting at my discretion as directed by my Physiotherapist." "This lets me stand when I want and provides a solution to my sore feet problem." "It's a great way to improve posture, stay focused and prevent sedentary behaviour." "It keeps me more alert throughout the class, less tendency to drift off, and reduces time sitting (as it presumably would not be available in every class)."
Barrier

"Too used to sitting down at a proper desk. Frequent back pains would prevent me from standing up for long periods of time." "I have a knee problem" "I tend to get a sore back to previous injury, Standing for extended periods of time tend to aggravate the injury"
Classroom Performance
Facilitator
"Some lectures are so long/boring need to be available to pay attention" "I have the option so once in a while I could stand up to stay more focused and stretch" "Keeps me alert" "It's the perfect solution as it allows both sitting and standing to change position and keep focus" "I feel like this would provide me the ability to change positions in order to help me concentrate" "Some classes are easier to fall asleep in, standing would help stay awake. Standing while speaking in class (for courses with discussions) also makes speaking more enthusiastic" "It's a great way to improve posture, stay focused and prevent sedentary behaviour." "I get fidgety during class and standing would help with that" "It keeps me more alert throughout the class, less tendency to drift off, and reduces time sitting (as it presumably would not be available in every class)."
Barrier
"Too much distraction during lecture of people rising and dropping their desks"

"It seems like a pain to adjust, and also distracting."

"Wouldn't want to interrupt the class if I wanted to adjust the table"

"I'd try it but would hate the distraction of people altering the desks"

"Would try it but not make it a habit, since id probably get tired and distract others"

"It would be distracting to other students"

"Too distracting for other people and myself - interrupts the lecture when desk makes noise to adjust"

"I think it would be very distracting to learning if everyone is moving the desk up and down."

"Useless and very stupid, it would hinder learning and distract people."

"Seems disruptive"

"It would be distracting."

"Distracting to students"

"It would be distracting to the rest of the class if I was adjusting my desk during the lecture"

"I prefer to sit while I am working. I find that sitting is more relaxing than standing and I am better able to concentrate on the course material when I am in a relaxed state of mind."

"Hard to concentrate. Plus, if students have a choice between sit-only and stand-only desks anytime, why bother with adjustable?"

"Moving out of seat or into seat is distracting for students behind me"

"I'd find it more difficult to concentrate."

"I believe the transition from sitting to standing would disturb the class"

"I would move around and fidget too much at a stand up desk"

"Can be disruptive during class, block view for other students, and I'm more comfortable sitting"

"I feel like majority of students would be fighting for a sit down desk and there's a lot

of short people on campus. For someone super tall to all of a sudden be standing up can really distract others." "Might be distracting to others to adjust the desk." "It may be distracting if multiple people are adjusting their desks during lectures." "I would be more prone to fidgeting/shifting (which I do while standing) and I would likely want to sit down 1, and shift a lot from standing to sitting. This might be because I'm out of shape though."
Social/ Environmental Factors
Depends on the day
"Depends on how tired I am rather than what classes I would be taking. However, if it is a course that requires strenuous note-taking, I'd prefer to be sitting down." "It's good to have options, depending on how sedentary the day is" "If I was really tired or feeling sick that day, I'd prefer to just sit the entire class" "Depends how tired I was" "Depends on how tired I am or if my legs/feet hurt, I would want the option to be able to sit or stand." "Depends when, how busy my day is and if it's after practice" "It would be easy to decide that day whether I wanted to sit or stand. I could make the decision based on how tired I was feeling." "Tiredness" "I would give it a try and see how I am feeling each day" "Depends on how I feel" "I would only use it if willing and not tired" "Depends on feel" "Depends on comfort level and laziness"

"This would depend on availability and whether I were tired of standing as standing has its own stresses and problems." "Depends on health condition of the day" "All classes would get tiring, but irregularly because some days I feel more tired than others." "Depends how I feel that day" "If I can't see the board or my butt gets tired from sitting" "Depending on the length of class, and my level of tiredness/soreness that day" "I would enjoy having the option of being able to stand up and let my body stretch after sitting for long periods of time. When I sit or stand depends on the day and how I am feeling." "I might use it if I'm feeling fidgety during the day which makes it hard to sit for long periods of time." "Some days I'm more restless then others so I'd want to stand. As well I wouldn't want to use it for my math class." "I would most likely get tired from standing so frequently so I would take some days to sit instead of stand." "When I was in undergrad I was really tired during class so 2rmally would nap lol"
Depends on the location/ availability
"I would use it to sit if all the normal chairs were taken" "It would block the view of other students behind me." "I can choose to stand if I want, but I can also sit if I'm tired; I wouldn't use it for some classes, since the sit-stand desks are at the back and I usually prefer to be up at the front for some classes to take notes" "I might use it, but it seems like an inconvenience for people behind you" "I feel I would be self conscious that I was blocking other students especially if they didn't have the sit stand desk. I also like to sit in the front rows to properly hear the

prof so I would be extra conscious if I felt I was blocking everyone in the back."
"Depends on location of desk relative to screens, outlets, doors, etc. takes time to adjust to correct height"
"If not everyone was standing, the ones who were would block everyone's view"
"This would depend on availability and whether I were tired of standing as standing has its own stresses and problems."
"If I can't see the board or my butt gets tired from sitting"
"Whether or not I would use it depends on how many desks are available - if there is only 1, I would likely not use it, but if there are many, I may use it if it is available."
"Can be disruptive during class, block view for other students, and I'm more comfortable sitting"
"It would be annoying to be sitting while the person in front of you is standing and blocking your view"
"I feel like majority of students would be fighting for a sit down desk and there's a lot of short people on campus. For someone super tall to all of a sudden be standing up can really distract others."
"Some people are taller than others - I like to be able to see my professor and the board."
"Depending on location of standing desks, you run the risk of being an obstruction of view for other students"
"Wouldn't want to draw attention to myself, I also have a hard time seeing and I think these desks would have to be at the back"
Depends on the social norm
"Too used to sitting down at a proper desk. Frequent back pains would prevent me from standing up for long periods of time."
"Depending on the business of the class and where my friends were sitting"
"If it was the norm I would use it, but if not I wouldn't."
"Wouldn't want to look weird in front of the class"

"It would be nice to not sit all the time, but I also think it would be socially awkward to not be sitting when everyone else is"
"It's a new concept so there would be social pressure to not use it"
"It would still be weird transferring from the sitting to standing position mid lecture"
"Embarrassing."
"Awkward if not everyone was standing"
"I have never used one and would try it out but would only continue to do so if they were being used by others. It is more functional for a study space than a lecture"
"It's weird unless everyone uses it."
"I'd feel embarrassed"
"It would be somewhat awkward because most students have other students that they tend to sit with. Using a standing desk during class would be an act of intentionally removing oneself from one's group"
Depends on the class type/ time/ task
"Depends on how tired I am rather than what classes I would be taking. However, if it is a course that requires strenuous note-taking, I'd prefer to be sitting down."
"I can choose to stand if I want, but I can also sit if I'm tired; I wouldn't use it for some classes, since the sit-stand desks are at the back and I usually prefer to be up at the front for some classes to take notes"
"Depending on length of class/ time of day (I wouldn't use it for a 3 hour lecture or early or night classes)"
"Depending on the business of the class and where my friends were sitting"
"Same reason as the standing desk"
"Same as standing desk"
"Can pick whether or not I'd want to stand; depends on the class"
"Depends on the lecture and the length of it"

"Most of my classes involved me needing to pay attention to a lecture so I don't think it's necessary. If the class involved actively doing work than I would consider it more necessary." "Depending on the time of day as in later classes id prefer to sit" "There would probably be a time that doing group would be easier if we stood around a desk" "There are some classes where I would prefer to sit (i.e., discussion-based classes, or classes that take place early in the morning when I am tired)." "Some days I'm more restless then others so I'd want to stand. As well I wouldn't want to use it for my math class."
Depends on the length/ number of classes
"It would be useful depending on how long the class is" "Depending on length of class/ time of day (I wouldn't use it for a 3 hour lecture or early or night classes)" "I would never want to stand for a whole class." "I feel like always standing for every class would become tiring and lead to sore legs" "If I have back to back classes I may want to sit during some classes but I would try to stand most of the time" "It depends the length of the class, but it would be good to stand and sit in the middle of classes to not get too tired from sitting" "I would use it for most classes, but if I have a lot of classes one day then I would probably sit for one class to rest my legs." "Again, if provided the opportunity would use it every class for portions of the class, but not the whole time." "I believe that I wouldn't be able to get used to standing at a desk, after going to school and taking classes sitting down for so long. Furthermore, for certain lectures that are longer (2+ hours), my legs would tire." "Would use in long classes (3 hour classes) cause it's tiring to be sitting all the time,

feels uncomfortable, want to stretch”
“I can't stand for that long”
“Depends on the lecture and the length of it”
“Depending on the length of class, and my level of tiredness/soreness that day”
“Won't use it for 3 hour classes”
“Most lectures are too long for me to remain standing”
“Would be too tiring to use all day”
“It keeps me more alert throughout the class, less tendency to drift off, and reduces time sitting (as it presumably would not be available in every class).”
<u>Dynamic Sitting</u>
Overall Perception
Supportive
“It looks fun”
“It would not be blocking others views and I would be able to keep a steady posture”
“I think it would be a fun way of sitting that would make you move around a bit more”
“This type of desk would be perfect to keep me engaged and alert”
“It’s better than not moving at all”
“It's good to have options, depending on how sedentary the day is”
“Its still sitting, and I don't use a back rest very often anyways.”
“Not really sure what a dynamic sitting desk is but it sounds helpful in tackling sedentary behaviours”
“Seems more convenient than the other desk options”

"Fun!"

"Comfy and good for my back"

"I am always looking to correct my posture and would use these desks to improve it"

"I don't mind anything as long as I'm sitting down."

"It is better to sit up straight in class to pay attention to the teacher, which doesn't make a difference from regular desks/chairs"

"I can still sit but at least my posture would be better"

"They look comfy and cool"

"I tend to move around a lot when I'm sitting in lectures anyways, so if these types of seats are provided to me I'd be very likely to use them for everything"

"Allows me to move around more."

"You do not need to stand, and therefore would not block any other students' vision and your legs would not get too tired"

"Could always use a bit of variation while I'm in class"

"I like having multiple things to do"

"I believe it would be more comfortable than traditional sitting desks."

"Because I do not like to sit during class time, especially for the 1 hour lecture"

"It looks pretty comfortable"

"It gives me something to do while in class"

This is what I use at home.

"Easy to implement. Enjoyable to use. Excellent trunk activation."

"Again, just to change things up from a normal chair, and to work on posture"

"It would probably look dumb unless other people are also doing it. If they are, it would be fun and I would always do it if available."

"I fidget a lot"

"I would enjoy having the option to move around during class"

"It looks fun"

"I believe it will help with core strength and keep your body moving so you don' t get stiff."

"It looks fun so I'd use it"

"I can see how it would be distracting, but it sounds fun"

"Fun"

"I believe it's a good thing to be able to have a dynamic sitting desk available"

"They look very comfy"

"Comfortable, but also engages the core. I fear however that it would be a source of distraction for the students."

"I may want to sit down at certain times"

"It's comfortable. Helps restless people. Great for students."

"Comfortable"

"I think it would keep me active while also allowing me to type"

"I still get to sit and it's better than a regular sit-down desk"

"Easier"

"I find it nice to have the option to be able to shift positions to avoid stasis of spinal fluid as well as to relieve pressure."

"Sitting on a ball sounds fun!"

"It would help me improve my posture, but I wouldn't want to use it all the time"

"Much more comfortable - easier to focus when comfortable"

"These desks provide an outlet for fidgeting behaviour and as far as I know do not aggravate my back injury"

"It seems comfortable and more easily adjustable"

"Fun" "It seems to be effective in allowing movement, but can be distracting" "It can keep me moving and more concentrated in lectures" "This lets me be less sedentary and provides a solution to my sore feet problem when I stand too much." "I always wanted a standing desk but 1 they are expensive"
Undecided
"Unsure what it would be like" "I would try it once probably for fun, but it might be too distracting" "I would try it out but I don't think I would like it." "I would want to try the desk to see if I enjoyed using it or if it helped me focus." "I would try it and see if I liked it" "I don't know what it is" "I would at least try it out to see if I preferred it" "I would want to try it out" "Never tried" "To try something new" "They would be cool to try, but I think I would be too distracted by it." "I'd try it" "Dynamic sitting desk" "I think it would be fun to try out" "Simply to try it"

“I would give it a try”
“To try it out”
“It would be nice to try”
“It’s something new to try and I like to try new things”
“I don't know if I will like it or not, so I would try it at least once.”
“I would like to try it but I'm not sure if I would use it for all my classes.”
“Maybe I’ll use it”
“Would definitely try”
“Just out of curiosity I would try it”
“I would maybe want to try it out”
“Undecided. Seems distracting”
“I don't know if would for me”
“Would compare it to a regular desk”
“I'd try it”
“I am not sure how this kind of desk would work.”
“I would test it out. But I would just find myself bouncing or not paying attention”
“Just to try it for fun.”
“If it works, I'd use it more often”
“Try it out”
“Not sure”
“I've never tried it - so I would definitely have to try it at least once and see how I feel about it.”
“I might try it out, but have no clue whether I'd make a regular habit of it or not”

Opposed
"I think it is stupid"
"Too used to sitting down at a proper desk. Frequent back pains would prevent me from standing up for long periods of time."
"It's SO distracting!!!!! I would get so annoyed. If someone needs some cushioning they can bring a seat pad"
"I find they can be uncomfortable."
"I usually get enough physical activity in my week"
"I prefer to sit"
"Doesn't interest me"
"I find them uncomfortable"
"Why though?"
"It looks uncomfortable, there is nothing to lean back on"
"I believe that I wouldn't be able to get used to standing at a desk, after going to school and taking classes sitting down for so long. Furthermore, for certain lectures that are longer (2+ hours), my legs would tire."
"Doesn't interest me"
"Seems impractical and that it would take up a lot of space; it would be hard to sit with friends"
"For use in class it seems unnecessary"
"I don't see any difference over a regular desk"
"It's uncomfortable"
"It doesn't personally look comfortable to sit at for a long period of time."
"The arrangement does not look comfortable."
"Not stable"

"I prefer comfortable seating. I have one class where the chairs are uncomfortable and I am always focused on how sore my back is and it distracts me from the content. I prefer for my seating to be something that I do not notice/think about because it does not interrupt my other activities.? "It's not a very stable "chair"" "They are probably good for you, but I just don't see myself using it." "Just seems too odd for me personally" "Students would break - waste of money." "The exercise balls wouldn't be practical in large spaces. Potential for accidents." "They look uncomfortable." "I have used both standing desks and dynamic sitting desks, because of regular exercise I find dynamic sitting desk to be more of an annoyance when compared to a standing desk" "I don't want to" "Seems uncomfortable to use." "Not as practical" "In class I need to focus and sit to write notes properly; also it's not as comfortable"
Personal Factors
Health/ Injury
Facilitator
"Changing seating positions in class makes me feel less stiff and helps circulate blood" "It's healthier" "Comfy and good for my back"

“I am always looking to correct my posture and would use these desks to improve it”
“I can still sit but at least my posture would be better”
“Easy to implement. Enjoyable to use. Excellent trunk activation.”
“Again, just to change things up from a normal chair, and to work on posture”
“I believe it will help with core strength and keep your body moving so you don’t get stiff.”
“Don't even know the function of a dynamic sitting desk.”
“Comfortable, but also engages the core. I fear however that it would be a source of distraction for the students.”
“I find it nice to have the option to be able to shift positions to avoid stasis of spinal fluid as well as to relieve pressure.”
“Looks like it reduces strain”
“It would help me improve my posture, but I wouldn't want to use it all the time”
“This lets me be less sedentary and provides a solution to my sore feet problem when I stand too much.”
“Some core work”
Barrier
“I have knee problems”
“It doesn’t look comfortable or stable, and would put undo stress on my back from the constant need for stability”
“I have a sensitive neck and back and require standard chairs with a back if I am to sit”
“Bad for posture”
“If it was a boring class and I fell asleep there's a higher chance of me falling off by accident”
“No back support. Feel like it would make posture worse.”

"They do not provide proper support and would become safety hazards when improperly used or played with" "The exercise balls wouldn't be practical in large spaces. Potential for accidents."
Classroom Performance
Facilitator
"This type of desk would be perfect to keep me engaged and alert" "Bouncing on the dynamic sitting desk really helps me focus at times, for example if I'm trying to think of something and it doesn't come to my mind, I strangely find that it'll come to me in a couple of bounces. It keeps my legs from getting too sore as well!" "Doesn't effect your normal class note taking routine" "Much more comfortable - easier to focus when comfortable" "It can keep me moving and more concentrated in lectures" "Some classes are easier to fall asleep in, standing would help stay awake. Standing while speaking in class (for courses with discussions) also makes speaking more enthusiastic"
Barrier
"Distracting" "I would try it once probably for fun, but it might be too distracting" "Wouldn't want to be distracting" "It's SO distracting!!!!! I would get so annoyed. If someone needs some cushioning they can bring a seat pad" "Too much variation, it would be distracting" "They would be cool to try, but I think I would be too distracted by it."

"Distracting"

"Don't want to be a distraction"

"Distracting from class"

"Too distracting for me and others"

"I think I would get distracted on it easily."

"I think this would be very distracting"

"All the motion going around may affect the teacher/lecturer?"

"Distracting and useless."

"I'd worry about balance. In addition, I think on the times where I was annoyed by others tapping their feet and realize that the bouncing that would ensue from these kinds of desks would be very irritating to see."

"It seems uncomfortable and distracting for other students"

"I would use it, however would be more distracted in class (I think)"

"It would distract me from paying attention to the professor."

"Undecided. Seems distracting"

"Distracting"

"I can see how it would be distracting, but it sounds fun"

"I cannot type while sitting on a yoga ball."

"It may get distracting, and there is no back rest"

"Comfortable, but also engages the core. I fear however that it would be a source of distraction for the students."

"I think it would be distracting to others."

I would feel distracted

"People wouldn't use it properly, it would be distracting"

"I prefer comfortable seating. I have one class where the chairs are uncomfortable and I am always focused on how sore my back is and it distracts me from the content. I prefer for my seating to be something that I do not notice/think about because it does not interrupt my other activities." "It doesn't look comfortable or stable, and would put undo stress on my back from the constant need for stability" "Distracting" "Seems distracting during class for others" "It is not easy to properly write notes" "I would test it out. But I would just find myself bouncing or not paying attention" "I've tried sitting on an exercise ball and felt it was difficult to stay balanced and keep focused on my work" "Comfortable, but easy to get distracted" "This can get really distracting and I feel I would bounce up and down whenever I get bored of the professor." "Desks like the ones shown would likely cause more disruption between class changes, and more distraction for students" "I would get distracted." "Intrusive to the classroom environment" "Too much of a distraction" "I wouldn't feel comfortable. I also feel this could be a distraction to other students if people are really bouncing around or moving on the ball - so these types of seats should especially be at the back of the class to limit distractions." "It seems to be effective in allowing movement, but can be distracting" "Based on the image of sitting on a exercise ball, I feel it would be too distracting" "In class I need to focus and sit to write notes properly; also it's not as comfortable"
Social/ Environmental Factors

Depends on the day
"It's good to have options, depending on how sedentary the day is" "Sometimes I want to sit with minimal distractions" "Depending on the mood and availability" "Depends when, how busy my day is and if it's after practice"
Depends on the location/ availability
"Depends on location of desk relative to screens, outlets, doors, etc." "Depending on the mood and availability"
Depends on the social norm
"Would depend on what others were doing" "It would probably look dumb unless other people are also doing it. If they are, it would be fun and I would always do it if available." "No, it's weird unless everyone is going to be sitting on one."
Depends on the class type/ time/ task
"I cannot type while sitting on a yoga ball." "If it was a boring class and i fell asleep there's a higher chance of me falling off by accident"
Depends on the length/ number of classes
"It doesn't personally look comfortable to sit at for a long period of time."

"Would not be good for too long of lectures" "Some classes can facilitate more movement than others" "It might not be comfortable for long periods"
Note. Some quotes appear under multiple categories.

Curriculum Vitae

Siobhan T. Smith

Post Secondary Education and Degrees

University of Western Ontario MD/PhD Program	09/2018
University of Western Ontario Kinesiology Thesis M.A.	09/2016
University of Western Ontario Kinesiology B.Sc.	09/2012-04/2016

Research Scholarships

CIHR Canada Graduate Scholarship – Master's (CGSM)	09/2017-08/2018
Ontario Graduate Scholarship (OGS) - Declined	09/2017-08/2018
Ontario Graduate Scholarship (OGS)	09/2016-08/2017
Faculty of Health Science Undergraduate Research Fellowship	11/2015

Publications

Fagan, M., Guirguis, S., Smith, S., Rollo, A., Sui, W., & Prapavessis, H. The Acute Effects of Nicotine and Exercise on Working Memory in Non-Smokers and Smokers. In-Preparation.

Smith, S., Deck, S., Fagan, M., & Prapavessis, H. Standing and dynamic sitting in the university classroom: perceptions of students and faculty. In-Preparation.

Smith, S., Fagan, M., LeSarge, J., & Prapavessis, H. Standing and dynamic sitting in the university classroom: a real possibility. In-Preparation.

Sui, W., Fagan, M., Smith, S., Rollo, S., & Prapavessis, H. Occupational Productivity Systematic Review. Applied Ergonomics. Revisions Requested. 02/2018

Rollo, A*., Smith, S*., Prapavessis, H. Do you want your students to pay more attention in class? Try dynamic seating! Journal of Ergonomics. 7(6). Published. 11/2017

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Smith, S., LeSarge, J., & Lemon, P. 2017. Time-restricted eating in women – a pilot study. Western Undergraduate Research Journal. 7(1). Published. 10/2017

Smith, S., & Prapavessis, H. 2017. “Standing up” for students: effects on classroom performance. International Journal of Ergonomics. 7(1). Published. 01/2017

National Conference Presentations

Standing and dynamic sitting in the university classroom: a real possibility (complete), Canadian Society for Psychomotor Learning and Sport Psychology (SCAPPS) Conference, Oral Presentation, St. John's NL, Oct. 2017, National

The effect of goal setting on daily step count of university students (proposal), Exercise is Medicine (EIM) Conference, Oral Presentation, London ON, June 2017, National

The effect of sitting, dynamic sitting, and standing desks on classroom performance of university students (complete), Canadian Society for Psychomotor Learning and Sport Psychology (SCAPPS) Conference, Oral Presentation, Waterloo ON, Oct. 2016, National