"Standing Up" For Students: Effects On Classroom Performance

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Abstract

It is known that there are many health risks associated with prolonged sedentary time, but breaking up periods of sitting can reduce these risks (Healy, 2008). University students experience excessive sedentary time during class. Hence, the purpose of this study was to determine the effect of sitting, dynamic sitting, and standing desks on classroom performance of university students. Based on a randomization sequence, 40 participants (*N* = 20, females, *M* age = 20.9) performed three classroom simulations using a classic, dynamic sitting, and standing desk. Each simulation included a typing and memory task. Participants were asked to type the paragraph displayed as fast and as accurate as possible while paying attention to a video. Following the video participants answered multiple-choice questions to assess memory. Results showed no significant differences in speed-accuracy or memory (all p values > .05, η^2 effect size range 0.001-0.027) between sitting, dynamic sitting, and standing desks.

Keywords: Standing Desk, Dynamic Sitting Desk, Classroom Performance, University Students .

1. INTRODUCTION

It is well established that there are many health risks (obesity, cardiovascular, bone, metabolic, cancer, etc.) associated with prolonged sedentary time [1]. However, research has shown that breaking up long periods of sitting can attenuate these health risks and lead to many health benefits [2,3,4,5,6]. Although breaking up periods of prolonged sitting with standing and light to moderate exercise has health benefits [2,3,4], 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 [7] 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 support by some studies [6,8,9], other studies on dynamic workstations have shown slower computer task performance [6,8,10]. Thus, research on this topic is equivocal at present.

University students experience excessive periods of sitting time during class and while studying [11]. 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.

2. METHODS

2.1 Participants

Participants (N=40; Age=20.9$\pm$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 (107403).

2.2 Intervention

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

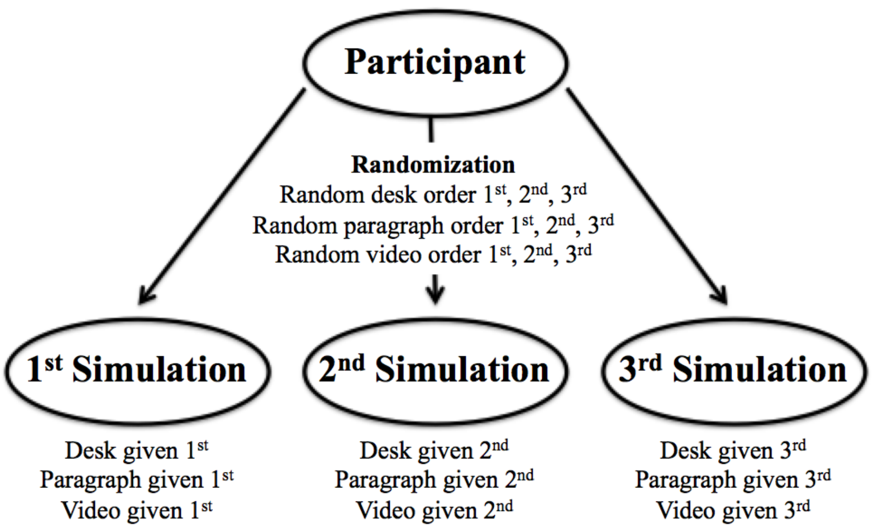

FIGURE 1: Randomization Sequence Flow Chart.

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 workstations [5,6,7]. 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 [12]**.** 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.

2.3 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 0.05. Descriptive data were presented as mean ± standard deviation (SD).

3. RESULTS

3.1 Manipulation (Fidelity) Check

Results from the ANOVA show that there are no differences for speed-accuracy between the 3 paragraphs ($F(2,115)=0.527$, $p=0.592$, $\eta^2_p=0.009$) and for memory between the 3 videos ($F(2,117)=0.463$, $p=0.631$, $\eta^2_p=0.008$). Thus, there are no paragraph or video difficulty differences.

Results from the ANOVA also show that there are no differences for speed-accuracy ($F(2,115)=0.169$, $p=0.845$, $\eta^2_p=0.003$) and memory ($F(2,117)=0.684$, $p=0.506$, $\eta^2_p=0.012$) for the simulations order (1, 2, and 3). Thus, there is no learning effect.

Desk	Speed-Accuracy WMP		Memory		Rating of ease and enjoyment	
	Mean	SD	Mean	SD	Mean	SD
Classic Sitting Desk	46.2	13.4	1.3	0.5	3.9	1.0
Dynamic Sitting Desk	45.6	12.8	1.3	0.6	3.7	1.1
Standing Desk	46.3	15.4	1.3	0.6	3.5	1.1

TABLE 1: Mean and standard deviation (SD) for typing speed-accuracy (WPM), video number of questions answered correctly (memory), and ease and enjoyment (rating) for the classic sitting desk, dynamic sitting desk, and standing desk.

3.2 Speed-Accuracy

There was no significant difference in the speed-accuracy (WPM) for the typing task between the classic sitting, dynamic sitting, and standing desks ($F(2,115)=0.030$, $p=0.971$, $\eta^2_p=0.001$, Table 1).

3.3 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 ($F(2,117)=0.097$, $p=0.908$, $\eta^2_p=0.002$, Table 1).

3.4 Rating Of Ease And Enjoyment

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 ($F(2,117)=1.628$, $p=0.201$, $\eta^2_p=0.027$, Table 1).

4. DISCUSSION

This study provides 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 Commissairs et al [7]. 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 [7].

Straker et al [8] 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 [8] and Funk et al [10] 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 done by Cao [6]. Cao 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 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 minute 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 minutes and Beers et al., 2008 showed no difference in clerical work over 20 minute period between office chairs, therapy balls, and standing desks [13,14].

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 [15]. Further, Husemann et al (2009) found no decrease in productivity for typing 4 hours a day for 5 days [16]. Additionally, a review by Karakolis et al also concluded that sit-stand workstations are likely effective in reducing perceived discomfort and do not cause a decrease in productivity in office workers [9]. 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 [5]. 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 ($p \leq 0.05$) for the therapy ball than standing yet there was no significant difference in energy expenditure between therapy ball and standing postures ($p > 0.48$) [14]. In the present study, participants showed no significant difference ($p > 0.05$) 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 intervention in fatigue, vigor, tension, confusion, depression, and total mood disturbance [17]. Results indicated participants felt more comfortable, energized, healthy, focused, productive, happy, and less stressed after using the sit-stand workstation [16]. 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 [18].

5. SUMMARY AND CONCLUSIONS

This study provides 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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