ORIGINAL ARTICLE

Ergonomics Workstation Intervention For Online Teaching And Learning During Pandemic

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Abstract: The COVID-19 pandemic has had a significant impact on teaching and learning environment whereby the use of digital learning has been used comprehensively. The issue of digital learning has received considerable critical attention on how the students dealing with prolonged online teaching hours. Questions have been raised about the ergonomics risk of prolonged online teaching hours. This study utilized the structural strategy of a method combining qualitative and quantitative analytic methodologies. The anthropometry data has been applied to determine the correct dimensions for the student's posture and how well the workstation would work. The survey and archive procedures were employed as research tactics to elicit responses to the study questions and achieve the research objectives. The finding indicates that neck pain is a frequent issue among students. Most student workstation components were changeable, but a few still require care. Regarding the provided goals, the aim was met, which was to determine that the ergonomic worksurface risk factor influences the severity and frequency of bodily pain. The results suggest that "the greater the duration of teaching and learning, the more intense and frequent the student's pain."

Keywords: COVID-19, Teaching and Learning, Ergonomics Workstation

1.0 INTRODUCTION

Due to the COVID-19 pandemic, most nations have implemented lockdown and social distancing measures, resulting in the shutdown of schools, training institutions, and higher education facilities. Transitioning from traditional face-to-face learning to online learning may be a different experience for the learners and the educators. There is no one-size-fits-all methodology for online learning as subjects and age groups demand different ways of online learning. The online classroom is a highly successful method of stimulating problem-solving, critical thinking, and self-directed learning [1]. However, it increases the abnormal strain when studying online compared to studying in the classroom physically.

According to Boatca *et al.*, [2] students spend more time inside, seated at a workstation, attending lectures, studying, and completing assignments while enrolled in online learning session.

Additionally, in Salima *et al.*, [3] students utilise a variety of furniture and equipment such as smartphones, desktops, and laptop computers, among others, with an incorrect body posture that is not ideal for the task at hand and may likely result in an ergonomic risk as shown in Figure 1.0 below.

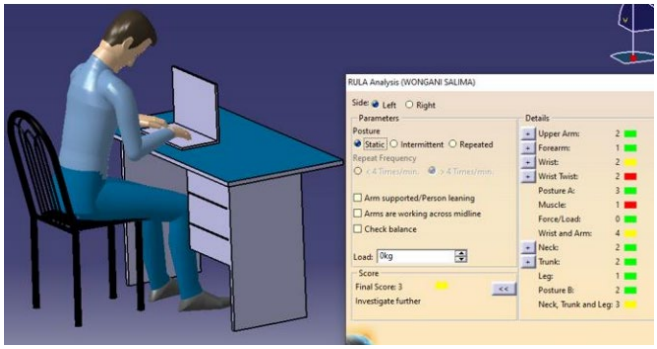

Figure 1.0: Incorrect body posture

For the past 30 years, ergonomic chair design has emerged as an important concern. Prolonged seating fixed and awkward postures are some of the risk factors which increase pressure on the human body causing Musculoskeletal Disorders (MSDs).

Various studies have been done on ergonomic chairs related to office work, classrooms, etc, however, there are limited research on appropriate workstation design, related to online learning. Therefore, in this study we will found out how intervention of ergonomics workstation is important to increase the productivity of student in performing their teaching and learning activity. To archive the aim, the survey related to ergonomics workstation will be performed which eventually the best way to set up workstations for maximum comfort while minimising ergonomic risk will propose.

2.0 METHODS

Research methodology is a systematic approach to solved research issue. To accomplish this research's purpose, the researcher utilizes two distinct types of data: primary and secondary. Primary data sources include questionnaire and observation. Secondary data is when the researcher relies on already-existing materials for the study and does not need to gather essential information from the field.

1) Determine Sample

There are two different types of sampling procedures will determine the sample for this study. The initial samples are convenience samples, which contain the subjects closest to the researcher and who will mostly be answering a questionnaire during the study process. Purposive sampling for site observation is used for the second set of samples. It is also known as judgement sampling since it requires the researcher to use their knowledge and skills to pick the most helpful sample for the research. Probability samples ensure that each instance in the population has an equal probability of getting picked. The researcher chose to utilise Krejcie and Morgan's (1970) Table of Sample Size, which researchers often use to calculate sample size . The main criterion in determining the sample as follows: 1) Highest number of learning time hours in particular selected semester. 2) Students who follow the correct programme structure. The following Table 1 presents the comparison learning hours for determining sample purpose.

Table 1: Comparison of Learning time for Bachelor Engineering Technology from first to seven semesters

Semester	Total Credit Hours Offered	Total Learning Hours
1	13	58
2	20	178
3	20	194
4	20	179
5	20	174
6	20	158
7	18	156

This study will focus on third-semester students because of the highest number of total learning. The total number of students that ongoing their third semester is 25 students. However only 8 students meet the second criteria whereby they follow the correct program structure that been designed by Institution.

2) Questionnaire development.

Aims of the current effort are to carry out a global survey of existing literature on Nordic Musculoskeletal Questionnaire (NMQ) applications across varied industries, knowledge domains, and geographical regions [4]. The NMQ is an essential and generic questionnaire that has been acknowledged and verified globally to detect neck, back, shoulder, and extremity pain [5]. It has 28 multiple-choice questions, divided into two sections that are distinct from one another. There are nine portions of the body where symptoms have occurred in the previous 12 months/7 days, and the first segment is referred to as the general section. The questionnaire was designed to answer the following question: "Do you experience excessive fatigue or discomfort in any part of your body because of your day-today-day teaching and learning activities?". The human body (viewed from the back) is divided into twelve anatomical regions that start from neck and be end with foot/ankle. Specific questions then concentrate on each anatomic region to study the frequency of pain that student felt when performing their activities.

The study started by conducting a survey to assess ergonomic risk associated with current students' workstations during the COVID-19 pandemic. The questionnaire was transmitted electronically and through WhatsApp, emails, and any other platform that allows for sharing the link.

Next, the researcher opted to utilise the site observation method to make the outcome of the data values and not in bias state. Site observation is a means to obtain data by watching people and events or recording the physical aspects of their natural context. Observations can be overt (subjects know they are being observed) or covert (do not know they are being monitored) (do not know they are being watched). First-hand familiarity with a location permits the researcher to be open to discovery and inductive, rather than assuming the context. For this study, the respondent knows they are being observed, and the researcher explains the objective of this approach. Table 2 shows summary of the analysis method for this study.

Table 2: Data analysis methods attempted in this study

Analysis	Method	Subject Under Test	Purpose
Normality	Graphical and statistical normality test	Section B & Section C	To ensure sample is normally distributed
Descriptive	Mean comparison	Section B & Section C	Identify central tendency of response
Relationship	Pearson's Correlation Coefficient test	Section B & Section C	Determine whether there is significant relationship between ergonomic risk factor to the frequency of pain and the level of pain

3.0 RESULTS AND DISCUSSION

1) Normality Test

The normality test for each data collection was done first before starting the next test. This is to ensure that the score distributions of the variables are normal. Result for normality test for this study presents in Table 3 below.

Table 3: Normality test

Variables	Skewness	Conclusion
Worksurface	0.090	Normal distribution
The Office Chair	-0.312	Normal distribution
Keyboard and Mouse	0.000	Normal distribution
Breaks	0.000	Normal distribution
Accessories	0.669	Normal distribution
Desks	0.000	Normal distribution
Lighting	-0.045	Normal distribution

Table 3 shown results indicates all independent variables are normal (sig value of more than 0.05 for Kolmogorov-Smimov statistics).

2) Ergonomics Workstation Checklist

Table 4 below shows the summary for the analysis to find the factors that impact the computer workstation design students encounter throughout their teaching and learning sessions. The result is based on the highest mean value.

Table 4: Ergonomic Computer Workstation Checklist

Workstation	Factor	Frequency (%)			Mean
		Yes	No	N/A	
Office chair	Seat pan is adjusted so that front edge sits about fist-width from back of calves?	3 (37.5)	4 (50.0)	1 (12.5)	1.75
Accessories	Is there a sloped desk surface or angle board for reading and writing tasks if required?	3 (37.5)	5 (62.5)	0	1.63
Accessories	Are you using a headset or speakerphone if you are writing or keying while talking on the phone?	4 (37.5)	5 (62.5)	0	1.63
Lighting	Your eyes are shielded from sources of direct glare	4 (50.0)	4 (50/0)	0	1.5
Lighting	The workstation is located between rows of overhead lights (where possible)	4 (50.0)	4 (50/0)	0	1.5
Keyboard and mouse	"When using your keyboard and mouse, are your wrists straight and your upper arms relaxed?"	4 (62.5)	2 (37.5)	0	1.38
Worksurface	Is your monitor positioned at least an arm's length away?	5 (62.5)	3 (37.5)	0	1.38
Worksurface	Is your monitor height slightly below eye level?	6 (62.5)	4 (37.5)	0	1.38

Compared to the other workstation design factors, the mean value of the office chair design factor for an adjustable seat pan in a student's workstation displays the most significant value of 1.75. It was discovered that four out of three students did not have access to an ergonomic chair equipped with a feature that could alter the level of seat pain. If students spend much time at their workstations, they may develop back discomfort throughout their academic life.

3) Analysis Level of Pain

The factors that influence the frequency and level of pain experienced by students followed by work risk factors to the body part are analysed and the results shown in Table 5 and 6 respectively.

Table 5: Summary for Level of pain

Body Part	Mean
Neck	3.63
Lower back	3.50
Shoulder(s)	3.25
Midback	2.38
Hip(s)	2.38
Foot/Ankle(s)	2.25
Knee(s)	2.13
Wrist/Hands(s)	2.00
Elbow(s)	1.88
Lower Leg(s)	1.75
Thigh(s)	1.63
Forearm(s)	1.25

With a mean of 3.63, item 1 is the body part that had the most excellent effect on the intensity of discomfort reported by students. Students suffered pain all the time (especially after work hours) due to teaching and learning. The duration of study hours in the third semester is 194 hours. Neck discomfort is one of the most common musculoskeletal disorders associated with prolonged computer use and a flawed workstation design.

For item 5, the lower back is the impacted body region for students throughout the teaching and learning session. It demonstrates the second-highest mean value at 3.50. Only 3 students (37.5%) had pain only during physical activity.

According to this study, Item 6, 7 students (87.5%) did not feel any discomfort associated with the body part. This might be because the workstation design does not affect the students' forearms. However, only one student (12.5%) had discomfort during physical activity.

Based on Table 5, the researcher can conclude that the majority of the discomfort reported by students is in the neck.

Table 6: Summary for Frequency of pain

Body Part	Mean
Neck	3.88
Hip(s)	3.63
Shoulder(s)	2.88
Lower back	2.75
Wrist/Hands(s)	2.63
Knee(s)	2.38
Lower Leg(s)	2.38
Midback	2.13
Thigh(s)	2.13
Foot/Ankle(s)	1.88
Forearm(s)	1.88
Elbow(s)	1.50

Table 6 demonstrates that students consistently suffer pain in their necks. The exact number of students engaged in pain 2-3 times per week every day with the highest mean of 3.88. (3 students or 37.5%). The second-highest mean value for midback was 2.88. Three students (37.5%) suffered midback discomfort once a month, whereas just one student experienced daily midback pain. The lowest mean value for thighs is 1.55. According to the study, none of the students reported discomfort.

3) Correlations Analysis

A significant relationship between ergonomic workstation design such as worksurface, the office chair, keyboard and mouse, breaks, accessories, desks, lighting on frequency of pain are analysed and shown in Table 7 while the level of pain in term of item is shown in Table 8.

Table 7: Correlation between workstation design checklist and level of pain

Ergonomic Workstation design checklist		Level of pain (Body)											
		Neck	Shoulder	Mid Back	Elbow	Lower Back	Fore arm	Wrist/ Hand	Hip	Thigh	Knees	Lower Leg	Foot /Ankle
Work surface	r_s	0.158	0.134	-0.390	0.161	0.805*	-0.434	-0.376	0.158	0.805*	0.591	0.811*	0.474
	sig	0.709	0.751	0.340	0.703	0.016	0.283	0.359	0.709	0.016	0.123	0.015	0.236
The office chair	r_s	-0.110	-0.497	0.034	0.119	0.041	-0.452	-0.581	0.466	-0.068	0.231	0.310	-0.055
	sig	0.796	0.211	0.937	0.779	0.924	0.261	0.131	0.244	0.874	0.582	0.455	0.897
Keyboard and mouse	r_s	0.000	-0.550	-0.051	0.105	0.506	0.733*	-0.366	0.410	0.101	-0.366	0.422	0.308
	sig	1.000	0.158	0.905	0.805	0.200	0.039	0.372	0.313	0.811	0.372	0.298	0.458
Breaks	r_s	0.459	0.761*	-0.057	0.585	0.396	0.378	0.000	0.000	0.623	-0.059	0.589	0.000
	sig	0.253	0.028	0.894	0.128	0.331	0.356	1.000	1.000	0.099	0.891	0.124	1.000
Accessories	r_s	0.591	-0.110	-0.742*	0.507	0.762*	-0.354	0.212	0.725*	0.550	0.425	0.759*	0.859**
	sig	0.123	0.796	0.035	0.200	0.028	0.390	0.614	0.042	0.158	0.294	0.029	0.006
Desks	r_s	-0.229	0.117	0.226	0.234	-0.396	0.378	0.176	0.229	-0.623	-0.527	-0.354	-0.229
	sig	0.585	0.783	0.590	0.577	0.331	0.356	0.678	0.585	0.099	0.180	0.390	0.585
Lighting	r_s	0.909**	0.417	-0.006	0.795*	0.660	0.257	0.371	-0.052	0.532	0.318	0.600	0.494
	sig	0.002	0.303	0.988	0.018	0.075	0.539	0.365	0.903	0.175	0.443	0.115	0.214

** Correlation is significant at 0.05 level (2-tailed)*
*** Correlation is significant at 0.01 level (2-tailed)*

With regards to ergonomic workstation design checklist and lighting, these factors have high correlation with neck and lower back with (r_s = 0.909, p = 0.002) and (r_s = 0.759, p = 0.018). It indicates a significant relationship between lighting in workstation design with neck and lower back. The accessories in workstation design have the most correlation and significance with the level of pain in the body part. Mid-back part shows inversely proportional to accessories (r_s = -0.742, p = 0.035) while the relationship between lower back is directly proportional (r_s = 0.762, p = 0.028). Next, hip and lower

leg is directly proportional to accessories and has significant relationship between them (r_s = 0.725, p = 0.042) and (r_s = 0.759, p = 0.029). Furthermore, the foot/ankle shows the highest correlation and significance with the accessories compared to other body parts. Correlation and significant value of (r_s = 0.859, p = 0.006).

Table 8: Correlation between workstation design checklist and frequency of pain

Ergonomic Workstation design checklist		Frequency of pain (Body)											
		Neck	Shoulder	Mid Back	Elbow	Lower Back	Fore arm	Wrist /Hand	Hip	Thigh	Knees	Lower Leg	Foot /Ankle
Work	r_s	0.211	-0.263	-0.310	0.397	0.234	0.503	0.530	0.208	0.842**	0.494	0.715*	0.806*
surface	sig	0.617	0.529	0.455	0.330	0.577	0.204	0.177	0.621	0.009	0.214	0.046	0.016
The office	r_s	-0.110	0.027	0.886**	-0.421	0.284	-0.469	-0.483	0.149	-0.165	0.690	-0.048	0.133
chair	sig	0.796	0.949	0.003	0.299	0.495	0.241	0.225	0.725	0.697	0.058	0.910	0.754
Keyboard	r_s	0.000	-0.308	-0.075	-0.077	0.585	-0.181	0.000	0.279	0.103	0.282	0.232	0.550
and mouse	sig	1.000	0.458	0.859	0.855	0.130	0.668	1.000	0.504	0.809	0.406	0.580	0.158
Breaks	r_s	0.459	0.229	0.281	0.462	-0.113	0.808*	0.577	-0.113	0.574	-0.113	0.462	0.293
	sig	0.253	0.585	0.500	0.249	0.790	0.015	0.134	0.790	0.137	0.790	0.249	0.482
Accessories	r_s	0.295	0.000	-0.395	-0.061	0.842**	0.014	0.101	0.742*	0.443	0.345	0.264	0.671
	sig	0.478	1.000	0.333	0.886	0.009	0.975	0.811	0.035	0.272	0.403	0.528	0.068
Desks	r_s	-0.115	0.000	0.281	-0.462	0.000	-0.173	-0.289	0.113	-0.574	-0.396	-0.462	-0.410
	sig	0.787	1.000	0.500	0.249	1.000	-0.682	0.488	0.790	0.137	0.331	0.249	0.314
Lighting	r_s	0.896**	0.546	0.236	0.706	0.423	0.582	0.141	-0.090	0.533	0.141	0.706	0.165
	sig	0.003	0.162	0.574	0.050	0.296	0.130	0.739	0.833	0.174	0.739	0.050	0.720

* *Correlation is significant at 0.05 level (2-tailed)*
** *Correlation is significant at 0.01 level (2-tailed)*

From Table 8, it was found that ergonomic workstation design factor of worksurface is directly proportional with thigh (r_s = 0.842, p = 0.009), lower back (r_s = 0.715, p = 0.046) and foot/ankle (r_s = 0.806, p = 0.016) with high correlation.

The correlation value of mid back shows the highest correlation with the value of (r_s = 0.886, p = 0.003). The results are directly proportional to the ergonomic design of the office chair.

The ergonomic lighting design at the workstation shows the highest correlation and significance to the neck with the value of (r_s = 0.896, p = 0.003). Next, the frequency of pain in the forearm shows a high correlation and significant value (r_s = 0.808, p = 0.015) with break time during teaching and learning sessions.

With ergonomic accessories, design at a workstation has a significant relationship with the hip and has the highest correlation (r_s = 0.742, p = 0.035).

4.0 CONCLUSION

The study has attained the desired outcome based on the anticipated response regarding the first objective. The results indicate that the longer the teaching hours, the greater the student's discomfort intensity and frequency.

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