

# **Ergonomics Assessment on the Mental Workload of Work from Home Employees**

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## **Abstract**

Working from home arrangement became a new trend for industries as they have to cope from the effects of the pandemic. The researchers found employees who work from home in the Philippines to be 70,649 in total. The purpose of the study is to ergonomically assess the mental workload of the work from home employees in the Philippines. The researchers used the Slovin's Formula to get the sample size of 156 where in total, they got 168 respondents. The NASA Task Load Index was used for assessing the mental workload of the work from home employees then underwent through Analysis of Variance Test to know if there are significant differences between the top four industries with the most number of work from home employees including--- Education, IT, BPO, and Financial; if there are significant differences between gender and age. As results of the study, they found out that respondents from all of the industries have very high mental workload with a result of 79.17 of mean of weighted rating.

## **Keywords**

Ergonomics, Work from Home Employees, Mental Workload, NASA Task Load Index, COVID-19 Pandemic

## **1. Introduction**

In 2018, October 13, the Senate and the House of Representatives passed the RA 11165 or an Act Institutionalizing Telecommuting as an Alternative Work Arrangement for Employees in the Private Sector. This aims to encourage employers to adopt telecommuting - a work arrangement that allows an employee to work from an alternative workplace with the use of telecommunication and/or computer technologies. For the technology improved a lot and continuously improving, this time is seen to be a great opportunity to switch into a new work arrangement that would be beneficial to both the employers and employees but is only limited to administrative and clerical works.

The researchers thought of an idea about conducting a study about the mental workload of work from home employees. In line with ergonomics, the findings, conclusion, and recommendations from this study could be beneficial for the employees working from home because of the pandemic and for the company who will continue the idea of working remotely—if it is ideal to continue this kind of work arrangement.

For businesses have changed some in their work system; if employees are required to work in the office before, many are now tapped to rearrange their work from office-based to their home. Though it is seen to be more convenient and is believed to give more time to bond with their families and loved ones, and not needing to commute with heavy traffics along the way, many of the work from home employees are giving sentiments about how the tasks hardly contributes to their mental workload. For this instance, we shall also consider something that is beyond just the work arrangement which is the mental workload of workers from home.

## 1.2 Objectives

This study aims to know how much is the mental workload of the work from home employees and how it influences their performance output and to introduce some approaches of ergonomics for an ideal work from home system.

Specifically, this study aims to:

1. Gather data to figure out which industries welcomed some changes in their work system and rearrange the workplace from office to work from home.
2. If the employees prefer work from home arrangement and agree to continue the arrangement even after the pandemic calms down.
  - 2.1. If they prefer this kind of work arrangement.
  - 2.2. If no, why do they not?
  - 2.3. If the arrangement is more convenient for them.
  - 2.4. If they agree that working from home is giving them more time to spend with their families and loved ones.
3. Study how working from home hardly contributes the mental workload of the employees.
  - 3.1. If the tasks demand higher performance from them with not enough resources to perform.
    - 3.1.1. If it ever made them anxious.
4. Asses the amount of mental workload of the work from home employees using NASA TLX as primary tool.
  - 4.1. How mentally demanding was the task for them.
  - 4.2. How Physically Demanding was the task for them.
  - 4.3. How hurried or rushed was the pace of the task.
  - 4.4. How successful they were in accomplishing what they were asked to.
  - 4.5. How hard they have to work to accomplish their level of performance.
  - 4.6. How insecure, discouraged, irritated, stressed, and annoyed they were.
  - 4.7. Which among the NASA TLX subscales mostly contributes to their mental workload?

Apply ergonomics approach for work from home arrangement and to provide system refinement that balances work from home and personal life; to establish boundary from personal life and life as employee while maintaining productivity at home working that matches or even outmatches the productivity an employee does at the office.

## 1.3 Scope and Delimitation of the Study

The study limits to the employees tapped to work from home in this time of pandemic. Survey was used by the researchers to identify what are the mental workload that employees facing at this kind of arrangement. This study uses qualitative and quantitative design which the National Aeronautics and Space Administration – Task Load Index (NASA TLX) was used by the researchers as the primary tool to assess the mental work load of work from home employees.

The respondents ages from 20 years old to 54 years old and 168 in total based on the results of the conducted survey being conducted. The respondents are limited to work from home employees in the Philippines only.

## 1.4 Significance of the Study

By reviewing the mental workload of the work from home employees, and assess how hardly they are being affected, this study would mean a lot and could help to ease the burden they are experiencing.

The study, at the same time, is focusing on the productivity of work from home in comparison to productivity from the office as influenced by too much mental workload. This is not a total comparison with technical application to determine the productivity of working remotely and in office. Interview and answers about their experience working from home and in office will be the primary basis.

Additionally, the study is also to differ and set a boundary of personal life from life as a worker; to give the two matters a dividing line that would not conflict one another. The study also discusses the importance of appropriate and systematic work system and work flow that opens a better working experience for the employees working from home, and for a healthier working environment. With that, the study would be very much beneficial not only to the employees, but also to the employers who are planning to opt to work from home or for employers who considers to continue this kind of arrangement.

## 2. Literature Review

According to Gössling et al. (2020), “with the magnitude of the COVID-19 pandemic, there is an urgent need not to return to business-as-usual when the crisis over”.

Given the results of the study of Mahammad, S., & Shareena, P. (2020), respondents working from home will be willing to work if they are having good and supportive environment to work from home. Understanding the needs of employees provides employers with an opportunity to help their employees set up a supportive and controlled work environment, which may result in a greater number of workers showing increased willingness to work from home and thereby having higher job satisfaction and efficiency.

Now that it is known to have industries switching to new work arrangement, Ziebell et al. (2020) studied that during the covid-19, teachers working from home juggled the increasing demand of their jobs; 68 percent of primary teachers and 75 percent of secondary teacher’s report working more hours per week while they moved to remote teaching. The study also said that nearly half of all teachers say they worked almost an entire extra day during this period, and some reported working in excess of 20 hours extra per week. Relative to the unwanted instances in work from home arrangement, the study of Johnson, E.B. (2020) states that, when you work from home, not only are you forced to deal with the normal pressures of a work day you also have to deal with the pressures of your normal living environment. Working from home means working with kids and pets and partners in-tow. It also means keeping strange hours or working from strange equipment in strange places. He also added that when you’re working from home, brace yourself for greater distractions (sure) but you also have to prepare for greater frustration from time-to-time.

Additionally, Bloom et al. (2015) indicated in their study with experimental data that employees, who can work from home, have an increased work effort. This result is in line with our empirical findings. Moreover, they find that employees, who work from home, are also more productive. Thus, implementing working from home seems to be a beneficial strategy for firms. This could also be the reason why in the study of Kimathi, S. (2020), they found out that major banks and financial institutions indicate that they will continue working from home for the foreseeable future despite easing of the lockdown due to the serious challenges they face, including safeguarding the health of employees.

One of the most widely used concepts in ergonomics and human factors and represents a topic of increasing importance (Young et al., 2015) which happens to be the same in the stand of Suhir. E. (2019) as stressed that, “MWL level is always important and is always considered when addressing and evaluating an outcome of a mission or a situation”.

As a synthesis to the all the related literatures, it is found out that there are advantages and disadvantages in a work from home arrangement. Although many of the related studies present the negative impact of the working from home: disruption, lack of time for personal life, and additional effort; in terms of company benefit, workers are seen to be more productive. However, it is also important to evaluate the result of a situation. Since it is also found that working from home requires additional effort, then it is considered as a subject to an increase in mental workload.

## 3. Methods

### 3.1 Research Design

This study uses a quantitative and qualitative research design as survey with NASA TLX as the primary tool was conducted. The researchers used survey questionnaires to identify which work from home employees of a particular industry employees experience too much mental workload. Slovin’s formula was used by the researchers to get the validity of the amount sample size. The NASA-TLX was used as the primary tool of the researchers to assess the mental workload employees working from home. The researchers also stratified age and gender per industry and the top four industries then used ANOVA Test to know if age correlates to the weight of their mental workload and if industries’ subscale scores differ from each other.

### 3.2 Sources of Data

The study used primary and secondary sources of data.

**a. Survey Questionnaires**

The survey was used to determine which industry has the most number of employees experiencing too much mental workload and gather some other significant data.

**b. Google Scholar**

It is popular among students and researchers who seek related literatures for their studies and researchers. It has thousands of published paper that can be accessed free of charge.

**c. Books**

Though the easiest way to get related literatures is through internet, the researchers still chose to get some from the books for books have good credentials in terms of getting related studies to back up or support the current study.

**3.4 Materials and Method**

- **Google Forms** – it is used by the researchers for creating and distribution of survey questionnaires and interviews.
- **NASA-TLX** – it serves as the primary tool to assess the mental workload of the work from home employees.
- **Slovin's Formula** – is used to calculate the sample size (n) given the population size (N) and a margin of error (e).
- **ANOVA** – or analysis of variance is a collection of statistical models used to conduct analysis between the differences of group means in a sample.

**3.5 Mathematical Expressions and Symbols**

**3.5.1 Sampling Technique**

Slovin's Formula was used to get the of sample size. The researchers took a sample size from 70,649 population size of employees who works remotely provided from a local news website OneNews.Ph (Jaymalin, M., 2020).

Formula for determining the sample size using Slovin's Formula:

$$N = \text{population size}$$
$$E = \text{margin of error}$$

$$n = \text{sample size}$$
$$n = \text{population size} / (1 + \text{population size} (\text{margin of error})^2)$$

The researchers determined the sample size for their survey to be 156 having 8% margin of error, the respondents reached by the researchers is 168 in total.

**3.5.2 National Aeronautics and Space Administration – Task Load Index (NASA TLX)**

The NASA TLX is proven to be accurate in measuring the mental workload of a subject by providing an overall workload score based on weighted average of ratings on six subscales: Mental Demands, Physical Demands, Temporal Demands, Performance, Effort, and Frustration.

The NASA TLX provided a formula for computing the weighted rating:

$$\text{Weighted Rating} = [(\text{Sum of Adjusted Rating})/15]$$

To determine the mean per mean per subscale, the formula is:

$$\bar{x} = \frac{\sum fx}{n}$$

$\bar{x}$  = mean  
 $f$  = frequency  
 $x$  = mid interval value of each rating

$$\sum fx = \text{sum of the product of mid interval value and their corresponding frequency}$$

To interpret whether the mean weighted rating is low, medium, high, or very high, the researchers used the scale interpretation authored by DiDomenico & Nussbaum (2008); Şeker, (2014) as cited in Campoya, Fabian & Hernandez, Juan & Maldonado, Aide & González-Muñoz, Elvia. (2020), and is presented in Table 3.1.

Scale Interpretation	
0-25	Low
26-50	Medium
51-75	High
76-100	Very High

Table 3.1. Scale interpretation

## 4. Results and Discussion

### 4.1 Data from the Respondents

The researchers prepared a survey with set of questionnaires to be answered by the respondents. The following results are presented below:

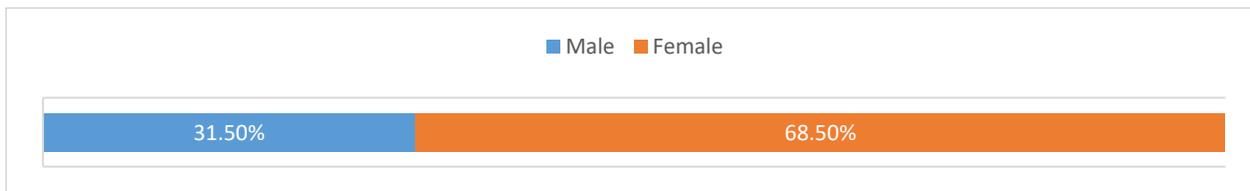


Figure 4.1. Gender of the respondents

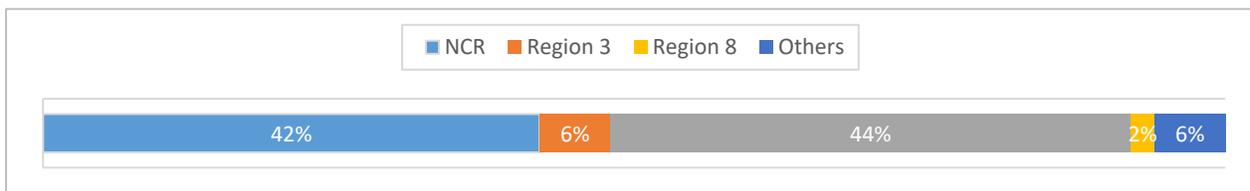


Figure 4.2. Location of the respondents

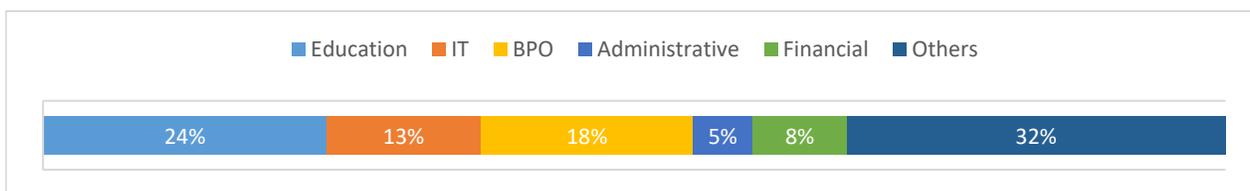


Figure 4.3. Industry/Sector/Work

Figure 4.1 shows that majority of the respondents are female. In terms of location, most of them live or work in Regions 3, 8, the National Capital Region and others (see figure 4.2). Figure 4.3 shows that respondents are from the industries/sectors like Education, IT, Financial, and Administrative.

#### 4.1.1 Survey Questions 1-6

The researchers also included sets of questions regarding the employees' thoughts and experiences with working from home in comparison to office-based arrangement.

**Q1:** Because of COVID-19, many businesses switched to a new work system where employees now have to work from home and consider to retain the same arrangement even if the pandemic calms down. Do you agree with that idea of new work arrangement?



**Q2:** Do you prefer working from home than in office?



**Q3:** Is working from home with the same office time and schedule more convenient for you?



**Q4:** Working from home will give you more time to bond and see your family or loved ones. Do you agree with that?



**Q5:** Were there times that the work demands higher performance from you yet lacking the resources needed to perform?



**Q6:** If yes, does that make you anxious?



Based on the result of the survey, employees who work from home agree to retain the same agreement even if the pandemic calms down. Although 75% of them agree about the idea of retaining the same arrangement, only half of them prefer to work from home than in office. Moreover, 66.70% of the respondents say that it is more convenient to work from home and that they have more time to bond with their families and loved ones. However, 80.40% of them find that they lack resources yet the work demands higher performance from them. Given that, 72.60% of them say that it makes them anxious.

#### 4.1.2 Figures for the NASA TLX Six Subscales

The NASA TLX provided six subscales for subjective measurement of workload. The respondents are asked to rate their mental demand, physical demand, temporal demand, performance, effort, and frustration when performing the task. The researchers provided 10 scales with 5 points corresponding to each scale. The figures presented below are the rates of the general respondents per subscale.

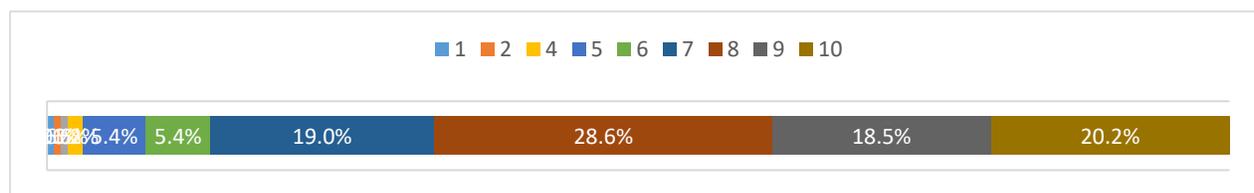


Figure 4.4. Mental demand scale

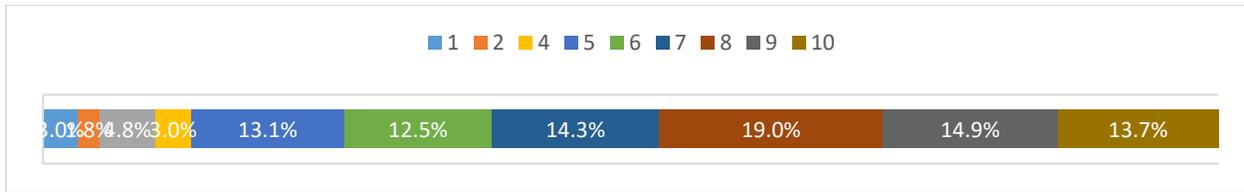


Figure 4.5. Physical demand scale

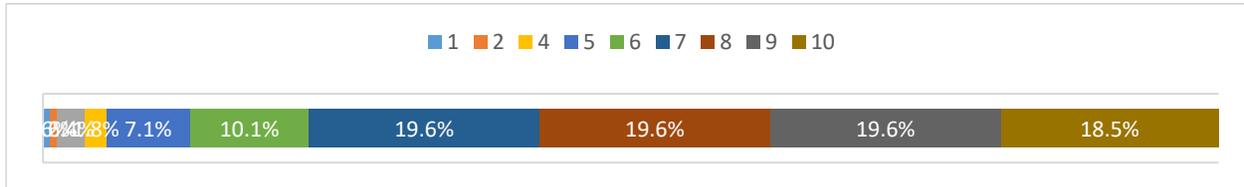


Figure 4.6. Temporal demand scale

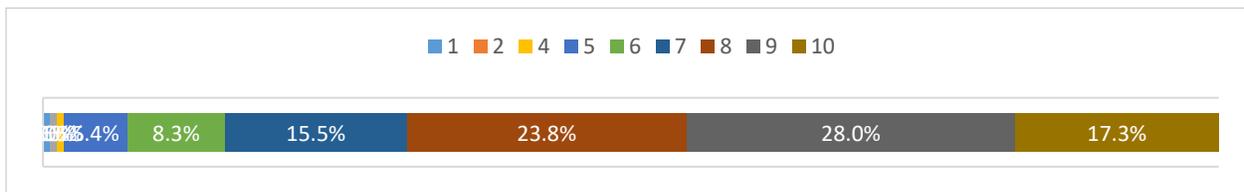


Figure 4.7. Performance scale

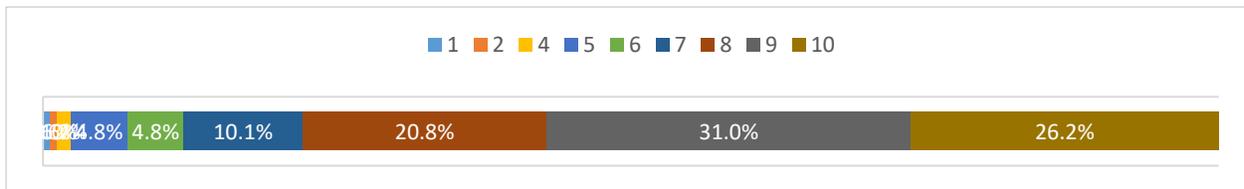


Figure 4.8. Effort Scale

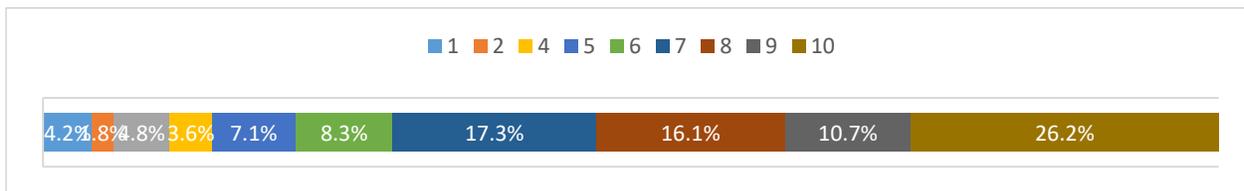


Figure 4.9. Frustration scale

According to the respondents, working from home is mentally demanding having the plurality rated mental demand scale at eight (8) while below that are the 20.2% of them who rated it at ten (10). In terms of physical demand, 19.07% of them, which is the plurality of the respondents who rated it at eight (8). Majority of them rated the temporal demand at 7,8, and 9 with all having 19.6% respondents respectively. Rating their performance seem to be satisfactory having 23.8% and 28% of the respondents rating their performance at 8 and 9 respectively.

Behind every good performance is a good effort, that shows with the effort scale where 31% and 26% of them rated their exerted efforts to finish the tasks at 9 and 10 respectively. That being said, it might be the reason as to why the results in frustration scale show that the plurality rated it at ten (10) with 26.2% among the total respondents.

Table 4.1: Mean of six subscales

Variable	Sample size (n)	Mean
<b>Mental Demand</b>	168	79.7
<b>Physical Demand</b>	168	69.6
<b>Temporal Demand</b>	168	76.8
<b>Performance</b>	168	80.4
<b>Effort</b>	168	83.6
<b>Frustration</b>	168	72.9

Unsurprisingly in the table 4.1, showing the mean per scale, many of the work from home employees agreed that they had to exert more effort just to meet the requirements of a task, the same result with the study of Bloom et al. (2015) that employees, who can work from home, have an increased work effort. Most of the respondents said that they have poor internet connection and lack of resources and equipment, so there were times that they had to double or even triple their effort just to finish the task. Though there is an increased in effort in a remote work arrangement, many of them were still able to perform well and finish their tasks with a satisfactory output having the mean of 80.4.

There is a low physical demand on working from home based on the mean of just 69.6. But there is more demand mentally when working at home. This is after the mean resulted to 79.7. Having no colleagues to rely on when in doubt and in trouble at performing the task keeps an employee to rely on itself.

Johnson, E.B. (2020) states that, Working from home means working with kids and pets and partners in-tow. He also added that when you're working from home, brace yourself for greater distractions (sure) but you also have to prepare for greater frustration from time-to-time. These instances reflect to the mean result of temporal demand with 76.8. Having the unexpected disturbance and being alone at work, poor internet connection, and lack of resources are what made the respondents to rate higher frustration when working at home and having a 72.9 of mean.

Table 4.2. Weighted rating worksheet

<b>Weighted Rating Worksheet</b>			
Scale Title	Weight	$\bar{x}$ Raw Rating	Adjusted Rating (WxR)
<b>Mental Demand</b>	4	79.7	318.8
<b>Physical Demand</b>	2	69.6	139.2
<b>Temporal Demand</b>	1	76.8	76.8
<b>Performance</b>	5	80.4	402
<b>Effort</b>	3	83.6	250.8
<b>Frustration</b>	0	72.9	0

**Sum of Adjusted Rating Column = 1187.6**

**$\bar{x}$  Weighted Rating = [(Sum of Adjusted Rating)/15] = 79.17**

*\*Weight is the tally of 15 point pairwise comparison, mean raw rating is the mean of the rating given by the sample size, and adjusted rating is the product of the weight and mean raw rating. The sum of adjusted rating is then divided by 15 to get the mean of weighted ratings.*

With mean weighted average of 79.17, it means that the 168 respondents who are in a work from home arrangement are having a very high mental workload.

Table 4.3. MWL comparison of the top four industries with work from home employees

Scale Title	Sample Size (n)	Mean per Industry			
		Education	IT	BPO	Financial
Mental Demand	168	79.8	80	79.6	84.62
Physical Demand	168	73.73	55	66	72.5
Temporal Demand	168	78.63	76.25	72.8	77.69
Performance	168	79.41	86.87	82	83.08
Effort	168	84.12	85	86.4	85.38
Frustration	168	75.29	73.75	66.4	65.38

Table: 4.4. Single factor ANOVA in terms of industries

SUMMARY						
Groups	Count	Sum	Average	Variance		
Education	6	47.0981	7.8497	0.1344		
IT	6	45.6875	7.6146	1.3225		
BPO	6	45.32	7.5533	0.7164		
Financial	6	46.865	7.8108	0.6273		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.3798	3	0.1266	0.1808	0.9082	3.0984
Within Groups	14.0029	20	0.7002			
Total	14.3827	23				

\* $H_0$  = There is no significant difference between industries.;  $H_a$  = There is a significant difference between industries.

The researchers conducted the ANOVA Test on whether industries have a significant difference or none.

The result of P-value is 0.91 it is greater than 0.05, therefore,  $H_0$  is valid—there is no significant difference of mental workload among the four industries.

The table 4.3 above presents the comparison of the mental workload of each of the top four industries with the most number of tapped employees to work from home. This is done to determine whether they differ in each subscale. From the figure 4.16, it only shows the general rating per scale of the respondents but it is unclear if each of the industry falls under that particular rating per subscale.

Table 4.3 presents that the financial industry suffers more mental demand working from home garnering a mean of 84.62 followed by the IT with a mean of 80. The education and BPO industries falls with nearly the same mean of 79.8 and 79.6. In contrary to the result of the mental demand, the workers from home in the IT and IT-BPO industries both have a lower physical demand. It is because more of them spends their time sitting in front of their computers retaining a sitting working position. There is also a lower physical demand with a mean of 73.73 than mental demand on the education industry for many don't have to attend to a physical classroom set up and do some physical-contact approach to their students, this is based on the answers of the respondents under the education industry. The same with education industry, financial industry also has a lower physical demand with 15% less than the mean of their mental demand.

The Education, IT, and Financial industries all have very high temporal demand with mean ranging from 76-80 while the BPO has high temporal demand with a mean of 72.8. For performance, the work from home employees in all industries reported a very high mean ranging from 79-87 which means, though they have a high to very high demand mentally, physically and in temporal, they still performed the tasks very well. Having the pandemic and doing the

tasks at home, all of the four industries had to exert a very high effort just to finish the tasks. This is after their mean resulted from 84-87. Moreover, the Education industry reported to have a very high frustration in performing their task assignments as their mean result is 75.29 while the frustration of the three industries are reported to be high with the mean of 65-74.

Table 4.4. MWL comparison of the combined top four industry employees according to age

Scale Title	Mean per Age Range		
	20-30	31-40	41-60
Mental Demand	82.9	77.6	77
Physical Demand	68.5	68.9	74.8
Temporal Demand	77.5	76.8	75.6
Performance	80.6	81.3	74.8
Effort	87	82.1	81.4
Frustration	80.6	65.1	67.8

Table 4.5. Single Factor ANOVA in terms of age

SUMMARY				
Groups	Count	Sum	Average	Variance
20-30	6	477.1	79.5167	39.0457
31-40	6	451.8	75.3	46.956
41-60	6	451.4	75.2333	19.3827

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	72.2633	2	36.1317	1.0286	0.3814	3.6823
Within Groups	526.9217	15	35.1281			
Total	599.185	17				

\*Ho = There is no significant difference between industries.; Ha = There is a significant difference between industries.

The researchers conducted the ANOVA Test on whether age have a significant difference or none. The result of P-value is 0.38 it is greater than 0.05 therefore Ho is valid—there is no significant difference of mental workload among ages of the workers from home from the four industries.

Table 4.6. MWL comparison of the combined top four industry employees according gender

Scale Title	Mean per Gender	
	Male	Female
Mental Demand	79.8	79.7
Physical Demand	66.4	71.6
Temporal Demand	77.7	76.4
Performance	78.9	80.8
Effort	84.1	83.5
Frustration	70	74.3

Use t-test tool  
 p-value = 0.3209

The researchers also conducted the t-test on whether gender have a significant difference or none.

The result of P-value is 0.32 it is greater than 0.05 therefore Ho is valid. —there is no significant difference of mental workload in terms of gender.

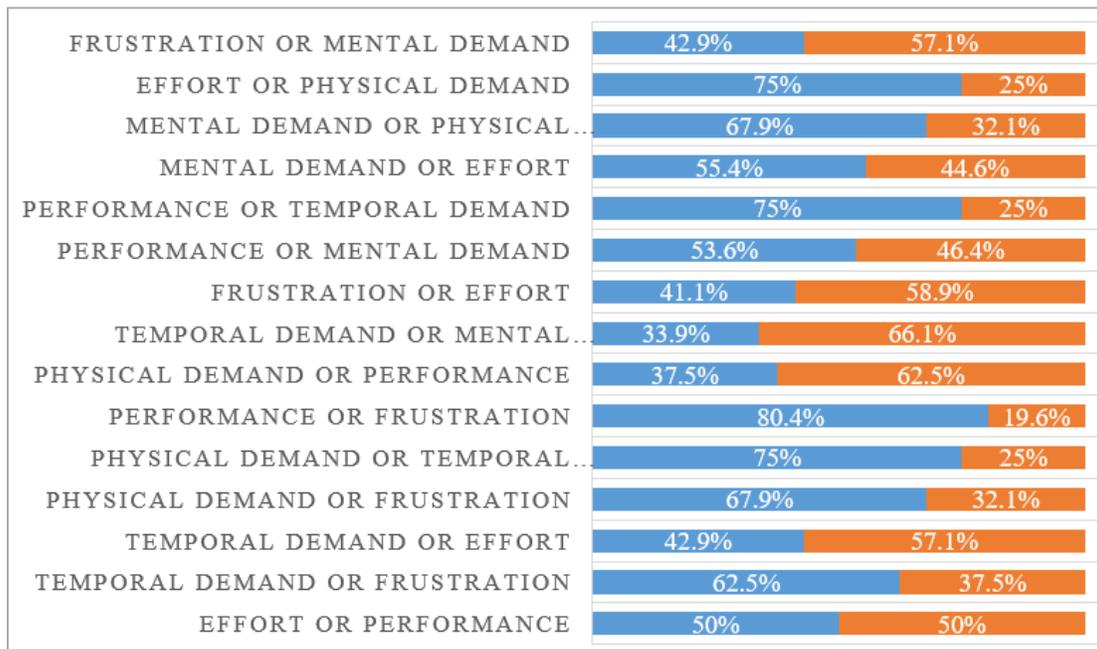


Figure 4.10. Fifteen Pairwise Comparison

NASA TLX also provided fifteen (15) pairwise comparisons. Although it has nothing to do with interpreting the mental workload of work from home employees, it does help to know which among the two compared things are they experiencing more when working with their tasks from home. It is important to know for employers to consider which part of delivering the task their employees are having a hard time balancing out the workload they give to their employees. Keep in mind that stable mental health and healthy working experience for employees would result in a positive and satisfactory output.

## 5. Conclusion

Although some results are contrary to each other, it still boils down to the same agreement—based on Q1 in section 4.1.1, 78% of the respondents agreed to continue this work arrangement as the curve flattens, however, only 56.50% of them prefer working from home. But even just a bit higher than half prefer it, 66.70% of them still think that it is more convenient compare to office-based having the same schedules of work (see Q2 and Q3 under section 4.1.1). Despite the convenience, with respect to the third objectives, many of them gets anxious especially in times where resources are scarce.

Emphasizing the main objective of the study, the researchers conclude that the respondents who were tapped to work from home in this pandemic have a very high mental workload. In terms of industry, age, and gender of the respondents, there are no significant differences concerning the weight of their mental workload. However, retaining the work from home arrangement is still ideal for a company or organization (who belong to industries/sectors/works: IT, IT-BPO, Education, Financial, Administrative) because aside from employees' preference to work from home, they are also more productive.

## 6. Recommendation

Upon the findings of the researchers, they were able to formulate a set of recommendation for the company to use when deviating their employees working from office-based to work from home with having low to enough mental workload. The company may consider the following:

1. Assign a person-in-charge (with high emotional quotient to handle a situation) that will keep in touch with the work from home employees when having problems with their tasks.
2. If there is a chance for workers to choose which work shift they want to attend to, make them choose. This is to avoid conflicts of duties at home and at work.
3. Schedule the distribution of tasks in advance so that the employee will be able to manage his/her time, and not to rush the pace of performing the task.
4. Provide a virtual world where colleagues may freely see each other virtually and comfort each other if having a problem at work.
5. Give them a time to break. There are times that the workers are still not able to take a break because of too much workload.
6. Provide the necessary equipment and resources to perform the task to avoid frustration and low productivity.
7. Provide a manual regarding ergonomic working—workout exercise manual, ergonomic table set-up, and ergonomic work posture guide.
8. Lastly, understanding the needs of employees provides employers with an opportunity to help their employees set up a supportive and controlled work environment, which may result in a greater number of workers showing increased willingness to work from home and thereby having higher job satisfaction and efficiency (Mahammad, S., & Shareena, P., 2020)

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