Effects of Online Classes on the Perceived Mental Fatigue: A Case Study of Undergraduate College Students of Mapúa University

Madeline Anne Patrice C. Sy, Maryam G. Irenea, Frankern Luis S. Malabuyoc Ma. Daniella M. Sobrevilla,
and Ma. Janice J. Gumasing
School of Industrial Engineering and Engineering Management
Mapua University
Intramuros, Manila, Philippines
mapcsy@mymail.mapua.edu.ph, mgirenea@mymail.mapua.edu.ph,
flsmalabuyoc@mymail.mapua.edu.ph, mdmsobrevilla@mymail.mapua.edu.ph,
mjjgumasing@mapua.edu.ph

Abstract

This study investigates empirically the effects of online classes on the perceived mental fatigue of undergraduate college students from Mapúa University in the Philippines. The current global pandemic and the abrupt shift from face-to-face classes to remote learning affected the mental health of the students. The researchers used data from a sample of 100 respondents obtained from a digital survey containing the Mental Fatigue Scale, which was then analyzed using descriptive and inferential statistics. Results presented a strong relationship between the academic workload factors during online classes and the overall mental fatigue level of students. Thus, results show that these factors significantly contribute to the level of intensity of the mental fatigue of college students. It was concluded that the demographics did not contribute to the level of mental fatigue of the students. Although the majority of the respondents sleep less than 8 hours, it presented no significant effect on the level of mental fatigue. This means that the academic workload of the respondents contributes to an elevated mental fatigue level. It is recommended that a change in the distribution of major/minor courses and proper time management will help decrease the level of mental fatigue of the students.

Keywords
Mental fatigue, online classes, academic workload

1. Introduction
Mental fatigue is identified as the psychological state as a result of long exposure to cognitive stress and activity (Maarten A.S. Boksem & Tops, 2008). This sensation is projected similar to tiredness or lack of energy, which is why it is not talked about often and in turn may cause negative implications that affect day-to-day human functions. This type of fatigue significantly differs from physical fatigue although mental fatigue has similar signs and symptoms to physical fatigue, they are separate biological functions, yet may co-exist (Fatigue Science, 2019). While physical fatigue exists due to exertion of excessive physical force, the mental state of an individual is unharmed and recuperation is only needed to resolve it, but it poses different implications to an individual who experiences mental fatigue. This type of fatigue is a result of an accumulated amount of mental strain which impairs an individual's capacity to handle stress (Mohan Garikiparithi, 2017).

Marcora et al. (2009) stated that mental fatigue has a direct effect when it comes to the physical performance of the person and further reiterated that the brain has a vital role when it comes to the regulation of endurance performance. In addition, Smith et al. (2019) justified that mental fatigue is a product of demanding cognitive activity, and as a result, mental fatigue could take in many forms behaviorally and physiologically. Aside from this, the researchers also stated that those types of mental fatigue are more distinguishable than the other chronic forms of fatigue such as the cognitive impairments that come with aging or diseases.

The declaration of the World Health Organization (WHO) of the novel coronavirus (COVID-19) outbreak as a global pandemic on March 11, 2020, has been the start of the magnification of mental fatigue due to the abrupt implementations of strict quarantine rules and the beginning of remote learning ("Managing Stress Associated with the COVID-19 Virus Outbreak Impact of the COVID-19 Outbreak on Individuals and Communities", 2020). The Jed Foundation from the United States conducted surveys involving mental fatigue, mental health, and stress to show how those conditions affect college students. Statistics show that out of 200 students across the country, 63% state that their emotional well-being is worsened upon the start of the COVID-19 pandemic which may be associated with mental fatigue and burnout (The Jed Foundation, 2020).

In support of the statistics by the Jed Foundation, studies have already proven that mental health affects the overall performance of the students ("Consequences of Student Mental Health Issues", n.d). It affects several factors such as the concentration and mental ability of the students which leads to dissatisfaction with their college experience and quality of life. Furthermore, a survey conducted by the American College Health Association in 2015 shows that stress, anxiety, sleep difficulties, and depression are the most evident health issues in college students (American College Health Association, 2015). In a work by Ribeiro et. al. (2018), they stated that while most of the studies about the quality of life of the students and its relationship with stress focus on the students in medical school, it is noted that the mental and physical fatigues that are associated with their work are a major contributor to the high levels of stress that may ultimately lead to the development of the burnout syndrome.

Concerning this, Gavelin et al. (2020) have stated that mental fatigue could be seen as a “central component of the cognitive and clinical characteristics of stress-related exhaustion disorder (ED)”. Furthermore, the study can be supported by Kocalevent et al. (2011), who stated that fatigue can be induced by the perceived stress that affects the person's performance as well as its function. In line with this, an article by Schiffert Health Center has also described the several fatigues that can be seen with college students, which includes psychological fatigue which is similar to mental fatigue that is caused by different illnesses such as anxiety, depression, and persistent stress (Schiffert Health Center, n.d). Which further justifies the relationship between stress and mental fatigue.

Mental fatigue could also contribute to the overall mental health of a person. According to Grillon et al. (2015), in which they identified that mental fatigue has a major role when it comes to emotional regulation. Further stating that mental fatigue could lead to decreasing motivation when performing a task, thus having more difficulties in regulating emotions. With these, the study by Berking and Wupperman (2012) shows that people who have a deficit in emotion regulation are related to different illnesses, such as depression. To support these, a narrative review by Compare et al. (2014), shows that emotional regulation has a strong connection with depression.

1.1. Objectives

Considering these, the main objective of this study is to establish the relationship of the effects of online classes on the perceived mental fatigue levels of undergraduate college students from Mapúa University. Under this primary objective, the researchers aim to determine factors that greatly influence the mental fatigue level of students and to distinguish how much those factors affect the mental fatigue of students.

2. Review of Related Literature

2.1. Average Sleep Duration

The American Academy of Sleep Medicine (AASM) and Sleep Research Society (SRS) conducted a joint consensus statement in 2015 wherein they underwent three (3) rounds of voting that utilized a modified RAND Appropriateness Method (RAM) to determine the recommended amount of sleep for a healthy adult. Both organizations considered health factors such as general health, cardiovascular health, metabolic health, mental health, immunologic health, human performance, cancer, pain, and mortality. Voting results from all rounds leans towards that healthy adults are recommended to have 7-9 hours of sleep since 6 hours or less is deemed to be unsuitable for daily optimal adult functions and the appropriateness of more than 9 hours of sleep is uncertain due to potential harms it may pose and may be an indication of poor health (Watson et al., 2015). Thus, providing a basis that a healthy individual who functions daily, such as college students, should have sleeping hours in between 7 to 9 hours, where 8 hours is the average.

2.2. Effects of Sleep Deprivation

Luca van Deursen (2017) administered a systemic review of existing systemic reviews and meta-analyses in terms of health outcomes caused by sleep duration. Findings show that inadequate sleep may increase fatigue on a day-to-day basis which may also lead to the stimulation of destructive emotions, predisposed depression, and suicide perchance. Given that, a study by Hanah Kim (2019) showed the effects of sleep deprivation on the academic performance of undergraduate college students from North Texas wherein a convergent parallel mixed-method approach was executed. Factors considered included are the school of the student, academic major, average number of sleep in hours, measure of academic performance (GPA), daytime sleepiness, sleep quality, and variables that may affect academic performance such as extracurricular activities.

It was concluded that a relationship between sleep deprivation and academic performance exists based on the results and data gathered from North Texas college students. It was stated that as the number of average hours of sleep increases, the daytime sleepiness decreases, and students have an improved quality of sleep, thus proving further that a correlation between average hours of sleep, daytime drowsiness, and sleep quality exists. The data analyzed in this study also indicates that students with a higher amount of sleep tend to perform better, academically wise, while those who do not get enough sleep may result to performing inadequately in their academics. Decreased hours of sleep at night cause students to have a lack of concentration throughout the day which may impair cognitive functions needed, particularly for college students in online classes, as to why this factor is significant in determining the mental fatigue levels of students.

2.3. Sleep and Fatigue

A cross-country comparative analysis in 2016 iterated that fatigue and insufficient sleep may cause productivity losses for companies (Hafner et al., 2016). While in 2019, a group of researchers from Reed Army Institute of Research conducted a study wherein they experimented with extending the sleep of a sample of 27 healthy adults, aged 18 to 39, to 10 hours for 7 consecutive nights followed by a single night of total sleep deprivation and a 10-hour recovery sleep period in a laboratory. Cognitive and sleep measures were determined using the Automated Neuropsychological Assessment Metric Version 4 (ANAM) and the Karolinska Sleepiness Scale. It was then revealed that extending the sleeping hours of the sample significantly elevated the fatigue below base level, while it did not yield a significant effect when it comes to mood improvement (Mantua et al., 2019). This is an indication that sleep extension is a feasible method for the reduction of fatigue.

2.4. Duration of Study

According to the study conducted by Alrhem and Almardeny (2014), planning, organizing, and directing indicated a strong positive relationship with the academic achievement of the students. In addition to the previous statement, the findings instill that the field of planning engraves boosting of student's morale (Abusakour, 2003). On the other hand, the expediency of energy in terms of mental health increased opportunities for advancement. Furthermore, time management contributes to the overall performance with regards to the online learning environment (Lim & Morris, 2005). This provides a systematic approach to effusing the productivity and comfortability of the students. Al-Zoubi (2016) also concluded that there is a significant relationship between how students manage their time and academic performance. Concerning time management, according to Ukpong and George (2013), there is a relationship between the duration of the study, whether longer or shorter and the academic performance of students. It was concluded in their study that students who spend long hours studying excel in academics as compared to those who study for a short duration. However, there are no studies directly linking the duration of study hours to fatigue and stress levels of students.

2.5. Screen Time

Long exposure to gadgets tends to rapidly slow down the cognitive process and communication skills. Active utilization of electronic gadgets is magnified due to the shift to online classes where daily screen time has increased and since students may tend to study for longer hours, they may experience fatigue due to this. Adverse effects may include physical manifestation of fatigue such as eye strain, blurred vision, tired eyes, headache, body pain, etc. (Coles-Brennan, C., Sulley, A., & Young, G., 2018). Thus, may lead to hindering students to perform efficiently in the academe and contributing more to the mental fatigue levels of students. According to Oberle, E., et.al., (2010), “longer screen time (≥2 h/day) was associated with lower levels of satisfaction with life and optimism, and higher levels of anxiety and depressive symptoms. For both boys and girls, mental health and wellbeing were most favorable if they participated in extracurricular activities and reported less than 2 h of recreational screen time per day”. Based on the data obtained, 8.5 out of 10 respondents study for more than 4 hours daily including online classes. A study conducted

by Oberle, E., et.al., finds that if a person obtains a screen time of ≥ 2 hours/day, he/she is prone to a high risk of depression, stress, and anxiety. Therefore, it can lead to an increase in the level of mental fatigue.

2.6. Academic Workload

According to Myny et al. (2012), heavy workload, as well as long working hours, have a significant contribution to fatigue, as cited in Bakshi, E., et al (2019). Furthermore, a study conducted by Kiekkas et al. (2008) on the relationship between stress and workload of nurses shows that workload is a major cause of occupational stress in the intensive care units. In an educational setup, according to the study by Lam et al. (2012), it shows that students tend to have negative perceptions when it comes to workload. However, according to Smith (2019), there are positive and negative effects on students when it comes to their workload. The positive effect of the workload on students is that it provides better work efficiency, higher GPA scores, and positive well-being; On the other hand, the negative effect is that higher workload tends to give students high-stress levels which ultimately may lead to a negative effect on their well-being. However, Smith also stated that although there is a presence of both positive and negative impacts of workload – these effects may occur at different times.

Another study that was mentioned earlier in the study by Ribeiro et. al. (2018), which states that most of the students in the medical field have high-stress levels due to the nature of their work as well as their workload. Concerning this, a study by Rahim et al. (2016) has stated that students have been established to be "stressed individuals" which relies on the amount of workload that they can manage. Furthermore, their study has also established when there is a sudden increase in the student's credit hours there is also an increase in their perceived stress. In line with this, stress related to academics have also been proven to have a negative relationship with the student's mental health, thus a need to cope with the academic stress is highly recommended so that it will not damage the students' emotional and mental health (Kiani et al., 2017).

While most of the studies surrounding workload are investigating its effects and perception has shown significant results. There is still no study that identifies the direct effect and relationship of the workload to the overall mental fatigue of a person.

Although mental fatigue is an established topic especially when it comes to analyzing its effects on physical performance as well as concerning the other illnesses and they provided strong evidence that mental fatigue could be related in different settings such as in sports and medical schools. However, there are limited studies that have been conducted that discuss the direct effect of mental fatigue on students, how the ongoing pandemic has caused mental fatigue, and lastly, the relationship between online classes and the students' mental fatigue.

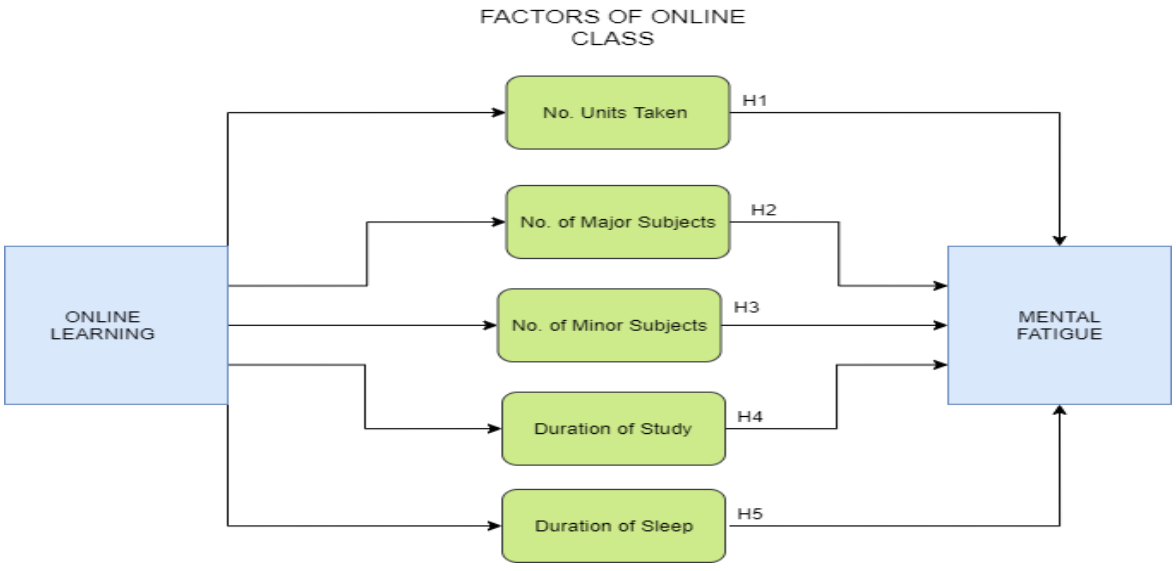

Figure 1. Conceptual Framework

2. Methods

2.1. Conceptual Framework

Figure 1 shows the different aspects that the study will focus on. Namely, the number of units taken for the term, the number of major courses for the term, the number of minor subjects for the term, the average duration of study as well as the average duration of sleep. The number of units taken, as well as the number of major and minor subjects, may be related to the amount of workload that the student has for the term. While the duration of study can be related to the working hours of the student. Since both workload and working hours are already proven to have a significant contribution to the mental fatigue of a person (Myny et al., 2012). The researchers also considered the duration of sleep as it was also proven to have a direct effect when it comes to academic performances (Kim, 2019).

2.2. Respondents of the Study

The researchers constructed a digital survey questionnaire containing three (3) components: student profile, student's study information, and a Mental Fatigue Scale (MFS) questionnaire obtained from a Brain Fatigue organization from Sweden. The student profile part involves basic profile details such as name, student number, age, and sex. The student's study information gets the number of units, number of major courses, number of minor or general education courses, number of classes per day, the average duration of study hours including online classes, usual area of study, and the average duration of sleeping hours. The Mental Fatigue Survey from Brain Fatigue contains 14 questions that aided in the identification of the level of mental fatigue the respondents currently experience. The digital survey was distributed to 100 respondents who are undergraduate college students of Mapúa University currently enrolled for the 3rd Quarter AY 2020-2021.

2.3. Ergonomic Tools

The main ergonomic tool that is used for the research is the Mental Fatigue Scale, which measures the overall mental fatigue score of the student which can be categorized under work physiology since it assesses how humans deal and copes with any strain from their environment.

2.4 Statistical Treatment of Data

The researchers used four (4) statistical treatments for the data (a) Descriptive statistics – which gives an overview of the respondent's profile and responses; (b) Inferential statistics, which gives an insight on the relationship between the different factors and the mental fatigue of the students. This includes the One-Way ANOVA Welsch's test, which determined if there is any significant difference between the factors; Correlation – Pearson Test, which shows the direction of the relationship of the variables; Lastly the Multiple Regression test, which shows how much a factor can affect the overall mental fatigue score of the student.

3. Results and Discussion

3.1 Respondents' Profile

For the profiling of respondents, 51% of the respondents are female and the remaining 49% are male. 73% of the respondents are aged between 18 to 20 and the remaining 23% are aged 21 to 23. When it comes to academic workload, 48% of the respondents have 10 to 15 units enrolled for this 3rd quarter AY 2020-2021, 40% with more than 15 units, and the remaining 12% with less than 9 units enrolled. Given that, 67% of the respondents have less than 4 major courses while 23% have 5 to 8 major subjects, and the remaining 10% have more than 8 major courses enrolled for the current term. The last part identifies the average duration of sleep in hours per day of the respondents wherein the majority of 81% of the respondents have less than the recommended 8 hours of sleep while the remaining 19% have 8 hours and/or above of sleep.

4.2 Mental Fatigue Scale Results

The last part of the data gathered is based on the Mental Fatigue Scale from the Brain Fatigue organization in Sweden wherein a Mental Fatigue Score per respondent was calculated according to 14 categories namely: fatigue, lack of initiative, mental fatigue, mental recovery, concentration difficulties, memory problems, slowness of thinking, sensitivity to stress, increased tendency to become emotional, irritability or "a short fuse", sensitivity to light, sensitivity to noise, decreased sleep at night, and increased sleep. The respondents were asked to rate the respective categories following their perceived level of fatigue. The summary of the result in shown in Table 1.

Table 1. Mental Fatigue Scale Scores for Each Category

MFS Score	Fatigue	Lack of Initiative	Mental Fatigue	Mental Recovery	Concentration Difficulties	Memory Problems	Slowness of Thinking
0	1	15	7	15	6	14	17
1	35	43	36	43	55	60	59
2	51	29	49	29	31	23	22
3	13	13	8	13	8	3	2
MFS Score	Sensitivity to stress	Increased tendency to become emotional	Irritability or "a short fuse"	Sensitivity to light	Sensitivity to noise	Decreased sleep at night	Increased sleep
0	10	24	17	50	28	20	44
1	41	52	47	33	50	53	35
2	34	15	32	16	18	19	15
3	15	9	4	1	4	8	6

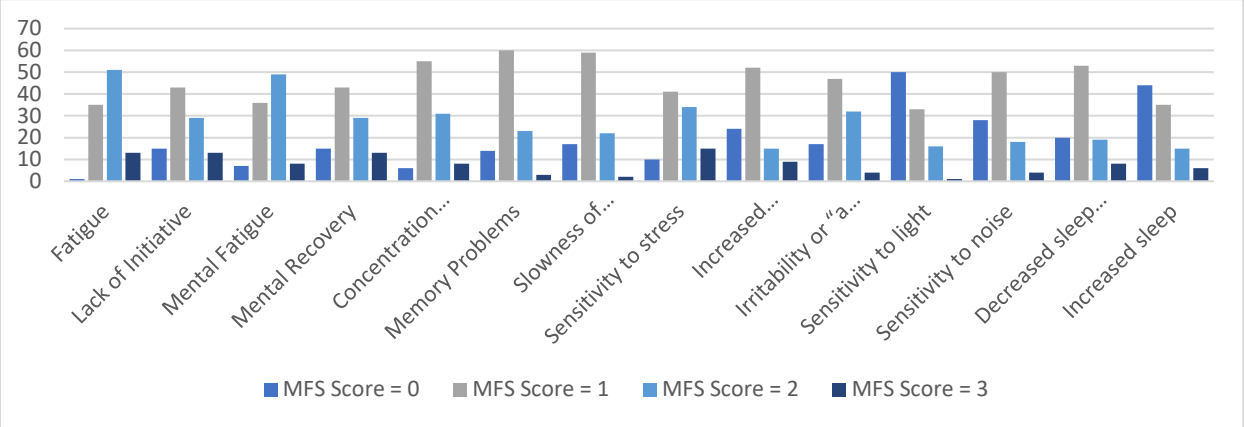

Figure 2. Mental Fatigue Scale Scores for Each Category

Based on the data gathered as shown in Table 1 and Figure 2, 51% of the respondents stated that they are often feeling fatigued most of the day and resting has little to no effect which is equivalent to the MFS score for fatigue is 2. 43% of the respondents picked the option which expressed that they find it difficult to start things they used to and would rather delay the start of it which is the equivalent MFS score of 1 for the lack of initiative category. While 49% responded that they become fatigued rapidly and must take a break more than often which is the corresponding score of 2 for mental fatigue. 43% of the respondents stated that they need to rest for more than an hour but do not necessarily require a night's sleep for them to recover mentally which corresponds to the MFS score of 1.

55% of the respondents responded that they sometimes lose concentration such as when reading or watching television which is equivalent to a score of 1 for the concentration difficulties category. 60% of the respondents feel that they forget things slightly more often than they should but can be manageable for memory problems which is the corresponding MFS score of 1. 59% of the respondents expressed that their thoughts are a bit slow when they have something to do that requires serious mental effort which is equivalent to a score of 1 for the slowness of thinking category.

41% of the respondents stated that they become more easily stressed particularly in situations that demanded much effort which seemed easily handled before and this corresponds to the MFS score of 1 when it comes to sensitivity to stress. 52% of the respondents said that they appear to be more emotional than other people but seem fairly natural but then start to cry easily with regards to things that affect them on a personal level which corresponds to the MFS score of 1 for the increased tendency to become a more emotional category. 47% of the respondents expressed that they are easily irritated, however, it is short-lived, which is the equivalent of a score of 1 for the irritability or "a short fuse" category.

50% of the respondents stated that there were no changes in their sensitivity to light which is equal to 0 for the sensitivity to light category. 50% of the respondents expressed that they have difficulty with loud noise sometimes but manageable and does not affect day to day functions which is then corresponding to the MFS score 1 for the sensitivity to noise category. 53% of the respondents experience slight difficulty falling asleep or that they sleep shorter, lighter, or more restless than usual which is equivalent to a score of 1 for the decreased sleep at night category. Lastly, 44% of the respondents do not experience increased sleep which corresponds to the MFS score of 1.

Table 2. Summary of ANOVA Result

Factor	Category	Mean	Std. Dev.	F-value	P-Value	Remarks
Gender	Male	16.71	5.81	0.85	0.360	Not significant
	Female	17.84	6.45			
Age	18-20	17.169	5.61	0.71	0.406	Not significant
	21-23	18.48	6.79			
# of units taken	<9	18.450	10.25	22.49	0.000	Significant
	9-15	18.354	18.354			
	>15	13.161	18.450			
# of major subjects	< 4	16.90	7.79	5.20	0.001	Significant
	5-8	18.24	4.46			
	>8	25.36	8.02			
# of minor subjects	1-3	16.57	4.89	5.12	0.031	Significant
	4-6	20.24	7.62			
Duration of study (hrs)	<4	16.23	4.65	5.34	0.003	Significant
	4-6	16.06	5.52			
	6-8	16.65	6.17			
	>8	21.10	5.91			
Duration of sleep	<8	17.33	6.08	0.93	0.343	Not significant
	8 and above	18.72	5.37			

Ho: There is no significant difference in the MFS score of students based on factors
Ha: There is a significant difference in the MFS score of students based on factors

3.3 One-Way ANOVA Results

Table 2 shows the summary data for the One-Way ANOVA analysis for the comparison of the MFS scores of the male and female respondents. The calculated p-value score is 0.36, which means that there is no significant difference found and indicates that sex does not affect the MFS scores of the respondents. For the age group, the comparison yielded a p-value score of 0.406, which means that there is no significant difference for that category and that age groups do not affect the overall MFS score. For the number of units taken on the current term, the calculated p-value score of this comparison is less than 0.001, which means that there is a significant difference in the MFS score based on units taken. Since the null hypothesis was rejected, a Post-Hoc test is necessary to identify which range on the number of units specifically generated significant differences. Since the comparison contains factors with unequal variances, the Games-Howell Post-Hoc test was utilized and yielded results which can be interpreted as the overall MFS scores of respondents with units less than 9 have a significant difference to those with enrolled units of 9-15 and greater than 15, while those with units of 9-15 and more than 15 are not significantly different. The next ANOVA test is for the number of major subjects. The numerical value obtained for the p-value score of this comparison is less than 0.001, which means that there is a significant difference and that the number of major subjects taken by the respondents this term affects the overall MFS score. The result of the Post-Hoc test revealed that overall MFS scores of respondents with more than 8 major subjects for this term have significant differences with those with only fewer than 4 and 5-8 major subjects, while those with less than 4 and 5-8 major subjects are not significantly different. Next is for the # of minor subjects taken, the computed value for the p-value score of this comparison is 0.031, which means that there is a moderate significant difference in the MFS score of students based on # of minor subjects taken. The MFS score of the respondents with 4-6 minor subjects has a significantly higher score compared to those with only 1-3 minor subjects this term. The next factor is the average duration of the study. The computed p-value score of this comparison is 0.003, which means that there is a significant difference and that the average duration of study per day in hours affects the total MFS scores. the overall MFS scores of respondents who study for more than 8 are significantly different from those who have an average duration of study in hours less than 4 and 4-6 while the remaining groups

do not have any significant differences. And the last factor is the average duration of sleep. The calculated p-value score is 0.343, which means that there is no significant difference found and indicates that the average number of hours of sleep per day, whether less or above 8 hours, does not affect the total MFS score of the respondents.

3.4. Pearson Correlation Analysis Results

The dependent variable for this comparison is the overall MFS score and the independent variables are, no. of units taken during the term, no. of major subjects, no. of minor subjects, the average duration of study per day, and average duration of sleep per day. The null hypothesis states that the correlation coefficient is equal to 0 while the alternate hypothesis states otherwise. The computed Pearson correlation value and p-value are shown in Table 3. The results show that factors that have a strong positive correlation to the mental fatigue score of students are no units taken, no. of major subjects, and average duration of sleep having p-value < 0.001.

Table 3. Pearson Correlation: Overall MFS Score vs. Units Taken

Factor	Pearson Correlation	P-Value	Remarks
Age	0.17	0.091	Not significant
No. of units taken	0.733	0.000	Significant
No. of major subjects	0.546	0.000	Significant
No. of minor subjects	-0.066	0.512	Not Significant
Ave. duration of study (hrs)	0.663	0.000	Significant
Ave. duration of sleep (hours)	-0.044	0.665	Not Significant

Shown in Figure 2 is the scatterplot of the relationship between the MFS and # of units taken by the students during the term. The strength of the relationship of the independent and dependent variables is based on the Pearson correlation coefficient which is equal to 0.733 or 73.3% which is close to 1 or 100%. This means that as the number of units taken by the student increases, the overall MFS score also increases.

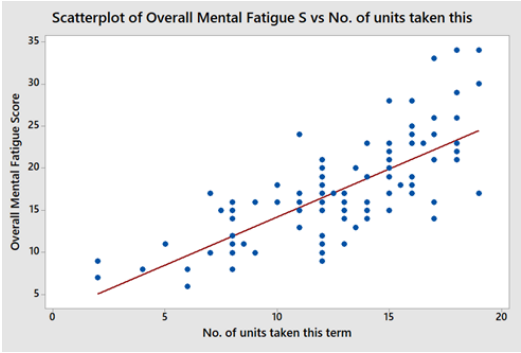

Figure 2. Scatterplot (With Regression) of MFS vs. Number of Units

Table 4. Result of Regression Analysis

Model Summary					
S		R-sq	R-sq(adj)		R-sq(pred)
3.28735		69.83%	68.89%		66.49%
Coefficients					
Tern	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-1.02	1.29	-0.79	0.429	
No. of units taken this term	0.789	0.100	7.89	0.000	1.32
No. of major subjects taken this term	1.193	0.400	2.98	0.004	1.37
Ave. duration of study per day	2.508	0.520	4.82	0.000	1.51

3.4. Regression Analysis Results

The regression analysis shown in Table 4 yielded an R-Squared value of 69.83% which means that majority or 69.83% of the mental fatigue is caused by the factors with significant differences based on the Pearson correlation analysis

which are: number of units taken this term, number of major subjects, and average duration of study per day in hours. The remaining 30.17% may be caused by other factors not tackled in this study.

The coefficients of factors show the amount of relationship of each factor to the dependent variable, MFS score. It indicates that for every increase in 1 unit increase for the units taken by the students, there will be an 0.789 increase to the mental fatigue, for every increase, there is a 1.193 increase to the MFS score, and for every hour increase in the average duration of study per day, there is an increase of 2.508 in the mental fatigue score.

The regression equation can then be used as a predictive model to determine the mental fatigue level by utilizing the number of units, the number of major subjects, and average duration of study per day since the factors mentioned are significant and the variance inflation factor (VIF) is less than 5.

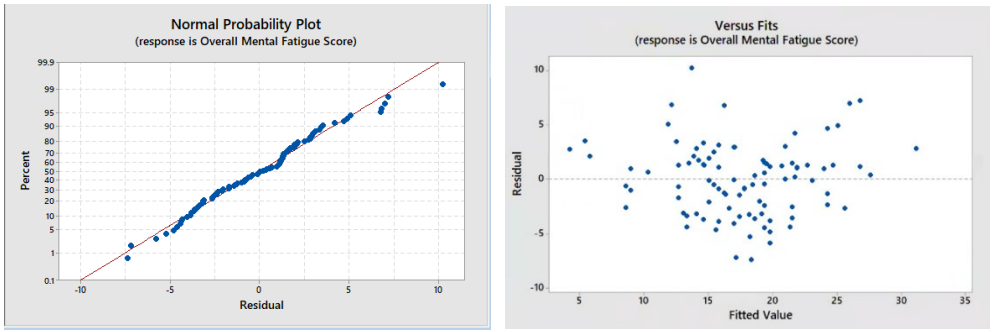

Figure 3. Normality Test and Residual Plots

The results underwent the normality test and the residual plot are shown in Figure 3 and were obtained to check if the model and analysis are accurate and valid. Based on the result, it is noticeable that the data lie on the line which means that the analysis from the regression model is valid and the model can be used. It also shows the residual plot that the distribution of data is equal above and below the line.

4. Conclusion

In this study, the researchers gathered data from 100 undergraduate college students from Mapúa University, and the Mental Fatigue Scale was used to determine the level of mental fatigue the respondents have which was then compared to factors such as duration of the study, duration of sleep, and academic workload for the current term. The demographics of the respondents such as sex and age did not affect the level of mental fatigue of the respondents, and even though the majority of the respondents sleep for less than 8 hours per day, it did not present any significant difference when compared to the overall mental fatigue score, which indicates that they do not directly affect the mental fatigue of this student for this set of respondents. This means that the academic workload of the respondents particularly contributes to an elevated mental fatigue level based on the results.

Results from the statistical analysis show that several factors from the current online class set-up have a direct effect on the mental fatigue of the students. Factors that exhibited significant differences are the number of units enrolled for the term, the number of major courses taken for the term, and the average duration of study per day in hours wherein the mental fatigue level is influenced by the mentioned factors by 69.83%. Since there were identified significant differences among those factors, further statistical tests were conducted to determine which factor under those contributed to the significant difference and to determine the strength and direction of the relationship.

However, for the number of minor subjects enrolled for this term, it was concluded that the mental fatigue level of the respondents with 4-6 minor subjects yielded a significantly higher score compared to those with only 1-3 minor subjects this term. But when the strength of the relationship was analyzed, it was seen that the independent variable does not have a major effect on the dependent variable. Although results from the prior statistical test contradict the correlation analysis, it can be concluded that the mental fatigue score of those with a greater number of minor subjects may cause the mental fatigue level of students to increase, but not significantly enough to establish a relationship between them.

For the number of units enrolled for the term, it was concluded that respondents with enrolled units less than 9 differ significantly from those with 9-12 and greater than 15 units enrolled for the current term. For the number of major subjects enrolled for the term, it was shown that respondents with more than 8 major subjects have significantly higher differences as compared to those with only less than 4 and 5-8 major subjects. For the average number of sleep per day in hours, it was concluded that students who study for more than 8 hours a day, including online classes, differ significantly as compared to those with only less than 4 and 4-6 hours of study per day.

Given that, it was seen and computed that the independent variables, specifically the number of units enrolled for the term, number of major courses, and the average number of sleep per day in hours, highly affect the dependent variable. This means that there is a strong positive relationship when compared individually with the overall MFS score and results show that as the number of units enrolled for the term, number of major subjects taken, and the average duration of study of the students per hour increases, the overall mental fatigue score also increases which means that the academic workload causes the rise of mental fatigue levels of students that affects their overall mental well-being.

5. Recommendation

Based on the results of the statistical analysis conducted, the researchers recommend the following;
For the institution, it is recommended to change the distribution of major and minor courses loaded on the student per term. Based on the results, a student's mental fatigue level increases because of the number of major/minor courses loaded in their curriculum. This means that the finalized workload of a student is statistically overwhelming. In addition to that, the results also showed that the average study hours of a student significantly affect the level of mental fatigue of the student. In theory, the average study hours of a student are correlated to the units loaded in their curriculum. Therefore, a change in the distribution of the student's workload will also change the study hours.

For the students, the amount of sleep shows no significant effect on the level of mental fatigue. However, the average study hours used do. It is recommended to properly manage the time used for leisure and other activities and academic responsibilities. Using an application or software that shows the timeline and due date could help with the ease and prioritization of workload. In addition to that, scheduling subjects/courses to take in advance could help with the preparation of one's mental state., If the workload is properly managed, it will provide the student ample amount of time to prepare and adjust based on the target workload.

For future researchers, since the study conducted is only limited to undergraduate college students of Mapúa University, it is recommended to widen the scope to high-school and grade-school students. Both departments offer different amounts of workload per student, therefore students from both departments may experience different levels of mental fatigue. Another, it is recommended to include the area of study on the factors that affect the intensity of mental fatigue of the students. Because of COVID-19, all classes are now delivered online. Therefore, change in the environment may have had an impact on the mental state of the student.

References

Al-Zoubi, M. (2016). *The Effect of the Time Management Art on Academic Achievement among High School Students in Jordan*. *7*(5). https://files.eric.ed.gov/fulltext/EJ1092359.pdf

American College Health Association. (2015). *National College Health Assessment II: Spring 2015 reference group executive summary*. Hanover, MD: Author. Retrieved from http://www.acha-ncha.org/reports_ACHA-NCHAII.html.

Bakhshi, E., Mazlomi, A., & Hoseini, S. M. (2019). Relationship Between Mental Fatigue and Mental Workload Among Nurses. Zahedan Journal of Research in Medical Sciences, In Press(In Press), 1–8. https://doi.org/10.5812/zjrms.83082

Bautista, A.G., Bautista, M., & Manuel, E. (2020). Mental Health of Students in the Philippines
during Pandemic: An assessment. Journal of Humanities and Social Sciences. 2. 316-323. 10.22161/jhed.2.5.2.

Benjamin LT, Jr. Lecturing. In: The Teaching of Psychology: Essays in Honor of Wilbert J. McKeachie and Charles L. Brewer, edited by Davis SF and Buskist W. Mahwah, NJ: Lawrence Erlbaum Associates, 2002, p. 57– 67.

Berking, M., & Wupperman, P. (2012). Emotion regulation and mental health: recent findings, current challenges, and future directions. Current opinion in psychiatry, 25(2), 128–134.

Coles-Brennan, C., Sulley, A., & Young, G. (2018). Management of digital eye strain. *Clinical and Experimental Optometry*, *102*(1), 18–29. https://doi.org/10.1111/cxo.12798

Commission on Higher Education. (2020). CHED COVID Advisory No. 6. https://ched.gov.ph/wp-content/uploads/CHED-COVID-19-Advisory-No.-6.pdf https://ched.gov.ph/wp-content/uploads/CHED-COVID-19-Advisory-No.-6.pdf

Deursen, L.V. (2017). *The effects of sleep duration on health: a systematic review of systematic reviews and meta-analyses*. *literatuuronderzoek_slaap_en_gezondheid_0.pdf (volksgezondheidenzorg.info)

Fatigue Science. (2019, April 11). *It's not just physical: The difference between mental and physical fatigue - Fatigue Science Public Website*. Fatigue Science Public Website. https://www.fatiguescience.com/blog/the-difference-between-mental-and-physical-fatigue/

Gavelin, H. M., Neely, A. S., Dunås, T., Eskilsson, T., Järvholm, L. S., & Boraxbekk, C. J. (2020). Mental fatigue in stress-related exhaustion disorder: Structural brain correlates, clinical characteristics and relations with cognitive functioning. NeuroImage: Clinical, 27(June), 102337. https://doi.org/10.1016/j.nicl.2020.102337

Geri, N., & Winer, A., & Zaks, B. (2017). A Learning Analytics Approach for Evaluating the Impact of Interactivity in Online Video Lectures on the Attention Span of Students. Interdisciplinary Journal of e-Skills and Lifelong Learning. 13. 215-228.

Grillon, C., Quispe-Escudero, D., Mathur, A., & Ernst, M. (2015). Mental fatigue impairs emotion regulation. Emotion (Washington, D.C.), 15(3), 383–389. https://doi.org/10.1037/emo0000058

Jahrami, H., BaHammam, A. S., Bragazzi, N. L., Saif, Z., Faris, M., & Vitiello, M. V. (2021). Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. *Journal of Clinical Sleep Medicine*, *17*(2), 299–313. https://doi.org/10.5664/jcsm.8930

Kiani1, Z. S., Latif, R., Bibi, A., Rashid, S., & Tariq, A. (2017). Effect of academic stress on the mental health among college and university students. MDSRC - 2017 Proceedings, 27–28.

Kiekkas, P., Sakellaropoulos, G. C., Brokalaki, H., Manolis, E., Samios, A., Skartsani, C., & Baltopoulos, G. I. (2008). Association between nursing workload and mortality of intensive care unit patients. Journal of Nursing Scholarship, 40(4), 385–390. https://doi.org/10.1111/j.1547-5069.2008.00254.x

Kim, H. (2019). The Effects of Sleep Deprivation on the Academic Performance of College Students. *International Journal of Scientific & Engineering Research*, *10*(5). https://www.ijser.org/researchpaper/The-Effects-of-Sleep-Deprivation-on-the-Academic-Performance-of-College-Students.pdf

Kocalevent, R. D., Hinz, A., Brähler, E., & Klapp, B. F. (2011). Determinants of fatigue and stress. BMC Research Notes, 4, 0–4. https://doi.org/10.1186/1756-0500-4-238

Lam, P., Mcnaught, C., Lee, J., & Chan, M. (2012). The impact of student workload on learning experiences (Issue 12).

Maarten A.S. Boksem, & Tops, M. (2008, November). *Mental fatigue: Costs and benefits*. ResearchGate; Elsevier. https://www.researchgate.net/publication/51426280_Mental_fatigue_Costs_and_benefits

Mantua, J., Skeiky, L., Prindle, N., Trach, S., Doty, T. J., Balkin, T. J., Brager, A. J., Capaldi, V. F., & Simonelli, G. (2019). Sleep extension reduces fatigue in healthy, normally-sleeping young adults. *Sleep Science*, *12*(1), 21–27. https://doi.org/10.5935/1984-0063.20190056

Mapúa University Central Student Council. (n.d.). Home [Facebook page]. Facebook. Retrieved May 2, 2021, from https://www.facebook.com/MapuaCSC/?ref=page_internal

Marcora, S. M., Staiano, W., & Manning, V. (2009). Mental fatigue impairs physical performance in humans. *Journal of Applied Physiology*, *106*(3), 857–864. https://doi.org/10.1152/japplphysiol.91324.2008

Memo From the ES March 18, 2020. (2020). Scribd. https://www.scribd.com/document/452154375/Memo-From-the-ES-March-18-2020?secret_password=GkiZH03cfEzjT4x4zcxi#from_embed

Myny, D., Van Hecke, A., De Bacquer, D., Verhaeghe, S., Gobert, M., Defloor, T., & Van Goubergen, D. (2012). Determining a set of measurable and relevant factors affecting nursing workload in the acute care hospital setting: A cross-sectional study. International Journal of Nursing Studies, 49(4), 427–436. https://doi.org/10.1016/j.ijnurstu.2011.10.005

Oberle, E., Ji, X.R., Kerai, S., Guhn, M., Schonert-Reichl, K.A., & Gadermann, A.M., Screen time and extracurricular activities as risk and protective factors for mental health in adolescence: A population level study, Preventive Medicine, Volume 141, 2020.

Rahim, M. S. A., Saat, N. Z. M., Aishah, H. S., Arshad, S. A., Aziz, N. A. A., Zakaria, N. N., Kaur, K., Kamaruddin, M. M., & Suhaimi, N. H. F. (2016). Relationship between Academic Workload and Stress Level among Biomedical Science Students in Kuala Lumpur. Journal of Applied Sciences, 16(3), 108–112. https://doi.org/10.3923/jas.2016.108.112

Ribeiro, Í. J. S., Pereira, R., Freire, I. V., de Oliveira, B. G., Casotti, C. A., & Boery, E. N. (2018). Stress and Quality of Life Among University Students: A Systematic Literature Review. Health Professions Education, 4(2), 70–77. https://doi.org/10.1016/j.hpe.2017.03.002

Smith, A. P. (2019). Student Workload, Wellbeing and Academic Attainment. Communications in Computer and Information Science, 1107(October), 35–47. https://doi.org/10.1007/978-3-030-32423-0_3

The Jed Foundation. (2020, October 22). *Survey of College Student Mental Health in 2020*. The Jed Foundation (JED). https://www.jedfoundation.org/survey-of-college-student-mental-health-in-2020/

Ukpong, D. E., & George, I. N. (2013). Length of Study-Time Behaviour and Academic Achievement of Social Studies Education Students in the University of Uyo. *International Education Studies*, *6*(3). https://doi.org/10.5539/ies.v6n3p172

UNITED NATIONS. (2020). *EDUCATION DURING COVID-19 AND BEYOND.* https://www.un.org/development/desa/dspd/wpcontent/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf

Vischer, J. (2007, February 8). The effects of the physical environment on job performance: Towards a theoretical model of workspace stress. Stress and Health, 175-184. Retrieved from Research Gate: https://www.researchgate.net/publication/227520676_The_effects_of_the_physical_environment_on_job_performance_Towards_a_theoretical_model_of_workspace_stress

Watson, N. F., Badr, M. S., Belenky, G., Bliwise, D. L., Buxton, O. M., Buysse, D., Dinges, D. F., Gangwisch, J., Grandner, M. A., Kushida, C., Malhotra, R. K., Martin, J. L., Patel, S. R., Quan, S. F., & Tasali, E. (2015). Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society on the Recommended Amount of Sleep for a Healthy Adult: Methodology and Discussion. *Journal of Clinical Sleep Medicine*. https://doi.org/10.5664/jcsm.4950

Biographies

Madeline Anne Patrice C. Sy is a 2nd-year undergraduate college student in Mapúa University - Intramuros, taking a degree in Bachelor of Science in Industrial Engineering. She is a current member and the Business Manager of Production and Operations Management Association of the Philippines (PROMAP) – Mapúa Intramuros Chapter. She took Practical Research in her years as a Senior High School student at Mapúa University – Intramuros. Her previous studies tackle disciplines with regards to student and school environment.

Maryam G. Irenea is a 2nd-year undergraduate college student in Mapúa University - Intramuros, taking a degree in Bachelor of Science in Industrial Engineering. She is a current member and the Financial Manager of Production and Operations Management Association of the Philippines (PROMAP) – Mapúa Intramuros Chapter. She took Practical Research in her years as a Senior High School student in St. Paul University.

Frankern Luis S. Malabuyoc is a 2nd-year undergraduate college student in Mapúa University - Intramuros, taking a degree in Bachelor of Science in Industrial Engineering. He is a current member and one of the Logistics Manager of Production and Operations Management Association of the Philippines (PROMAP) – Mapúa Intramuros Chapter. He took Practical Research, and Capstone in his years as a Senior High School student in Don Bosco College – Canlubang. His previous studies tackle agriculture, social media, and other factors involving human well-being.

Ma. Daniella M. Sobrevilla is a 2nd-year undergraduate college student in Mapúa University - Intramuros, taking a degree in Bachelor of Science in Industrial Engineering. She is a current member Philippine Institute of Industrial Engineers (PIIE) – Mapúa Students Chapter. She took Practical Research in her years as a Senior High School student at Mapúa University – Intramuros. Her previous studies tackle service improvement and transportation systems.

Ma. Janice J. Gumasing is a Professor of the School of Industrial Engineering and Engineering Management at Mapua University, Philippines. She has earned her B.S. degree in Industrial Engineering and a Master of Engineering degree from Mapua University. She is a Professional Industrial Engineer (PIE) with over 15 years of experience. She is also a professional consultant of Kaizen Management Systems, Inc. She has taught courses in Ergonomics and Human Factors, Cognitive Engineering, Methods Engineering, Occupational Safety and Health, and Lean Manufacturing. She has numerous international research publications in Human Factors and Ergonomics.