

## Measurement of student mental workload during online learning using Continuous Subjective Workload Assessment Technique (C-SWAT)

Lisa Melvi Ginting<sup>1,\*</sup>, Hasianna Nopina Situmorang<sup>1</sup>, Ferry Indra Sakti H. Sinaga<sup>1</sup>, Yoakim Simamora<sup>2</sup>

<sup>1</sup>Mechanical Engineering Education, Faculty of Engineering, Universitas Negeri Medan, Medan 20221, Indonesia

<sup>2</sup>Electrical engineering education, Faculty of Engineering, Universitas Negeri Medan, Medan 20221, Indonesia

\*Email: Ls.ginting@gmail.com

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**Abstract** *The covid-19 pandemic have effect in Indonesia both financial and non-financial sector include education. There is new habit on education system such as online learning. Since online learning student use gadget/computer to learn. Using gadget in high frequencies may cause effect. This research to measure mental workload of student during online learning in Mechanical Engineering Education Department. Mental effort is measured use continuous subjective workload assessment technique. Continuous subjective workload assessment technique (C-SWAT) is simplify of subjective workload assessment technique. In continuous subjective workload assessment technique, participant is asked dimension that participant prefer, after that participant is asked to do simple arithmetic test. Dimensions are time load, mental effort and psychology-effort. This research use minimum weight of 0 ( $W_0$ ) with weight used is 1/3. Moreover, there is questionnaire to know study interest of participant during online learning. In this research mental effort load is the second highest score, the first highest score is psychology stress effort. Multiplication test is high score than other arithmetic test. During online school student have fatigue, most of them feel eyestrain and body sore. Student prefer synchronous learning type than a-synchronous learning it's because in synchronous learning student can discuss with teacher directly.* [MEASUREMENT OF STUDENT MENTAL WORKLOAD DURING ONLINE LEARNING USING CONTINUOUS SUBJECTIVE WORKLOAD ASSESSMENT TECHNIQUE (C-SWAT)] (*J. Math. Nat. Sci.*, 1(2): 40 - 45, 2021)

**Keywords:**  
Continuous, Subjective  
Workload Assessment  
Technique, Online  
Learning, Mental  
Workload

### Introduction

The Covid-19 virus pandemic continues in Indonesia. The latest variant virus has entered Indonesia. In 2021 the Covid-19 pandemic was still hitting Indonesia. Many aspects were experiencing changes, both financial and non-financial. One of them is education sector. The Covid-19 pandemic has changed the learning system, which used to be face-to-face learning system at classroom has changed to online with virtual class.

The learning method before the pandemic was face-to-face, because the pandemic, learning method has changed to distance learning. Distance learning is using virtual class such as ZOOM, Google Meet, MOOC, etc. Department of Mechanical Engineering Education, University of Medan use online-learning platform such as

Zoom, Google Meet, Google Classroom, and SIPDA (type of MOOC) in learning system. Changes learning method may impact on student. The use of devices such as computers, smartphone, gadgets in high frequency may cause effect. The effect such as headaches (Lima and Coelho, 2018), sleep disturbance, depression, smartphone addiction (Haug et al., 2015).

Based on the description above, it is important to measure mental workload online learning during pandemic. Changed learning style from face-to-face in class to learning through networks have impact to student. In this study, researchers measure mental workload of student during online learning at Department of Mechanical Engineering, University of Medan.

Cognitive ergonomics is a branch of ergonomics that deals with human mental

processes including perception, memory and reactions, as a result of human interaction with the use of system elements. Cognitive ergonomics seeks to investigate mental processes in humans in an objective and scientific way (Hutabarat, 2018).

Subjective Workload Assessment Technique (SWAT) is one of method to measure mental workload. Continuous Workload Assessment Technique (C-SWAT) is simplified of SWAT measure mental person's workload. Previous research discussing SWAT, one of which was research conducted by Sabrini et al. (2013), who conducted research on the workload of employees at PT. XYZ. The research was conducted after finding problems related to delays in processing documents or reports with gas station and LPG agents. Meanwhile, research conducted by Maulana et al. (2019) that the implementation of SWAT can be carried out to measure the cognitive workload of the ABC Minimarket Cashier Officer which shows that the Time Load (T) factor is more dominant.

## Materials and Methods

Research was conducted in Department of Mechanical Engineering, University of Medan. Total respondents were 110 respondents. This research was conducted between Augusts to December 2021 during online learning. Data was collected using questionnaire and data analysis technique using SPSS and Microsoft Excel.

Online learning can be grouped into Synchronous (learning with a scheduled time or real time) and asynchronous (learning with an unspecified time and content is provided online). Synchronous learning model such as lecturers explaining material via virtual meeting applications also on that time, discussions can be held during the lecture period. Virtual meeting applications such as Google-meets, Zoom, or other similar applications. While Asynchronous learning, the lecturer provides a video recording/learning material at an unspecified time such as MOOC, etc. Both types of online learning have their respective burdens.

Both Continuous Subjective Workload Assessment Technique (C-SWAT) and Subjective Workload Assessment Technique (SWAT)

method are used to measure a person's mental workload. The Subjective Workload Assessment Technique (SWAT) method is one method of measuring mental load (Muslimah et al., 2014). Now days, there are many method for mental workload measurement, one of them is Continuous Subjective Workload Assessment Technique (C-SWAT). One of the advantage of C-SWAT method is saving time than SWAT. SWAT method require participant to sort twenty seven card from lowest to highest based on participant preference. This study uses the Continuous SWAT method using the Pairwise Comparison (PWC) procedure (Luxiomon and Goonetilleke, 2001).

In this research procedure respondents were asked to choose which dimension was more important based on the respondent's preferences in lectures during online learning. These dimensions include the time load dimension, the mental effort dimension and the psychological stress dimension. Time load shows the amount of time available in planning, implementing and monitoring time during online learning, while mental effort estimates how much mental effort while study in online lectures. Psychological stress effort measures the amount of risk, confusion, frustration associated with performance in online learning. After selecting the dimensions, respondents were asked to perform arithmetic tasks with different levels of difficulty by doing two times test. Arithmetic tests involve performing simple calculations such as addition, subtraction, and multiplication. After that, a synchronous learning test is carried out, in this test, after the lecturer gives direction, a final test or posttest is held. While the test in asynchronous learning is carried out a final test/posttest after students carry out independent learning, namely by reading the lecture module. The test media use Google form.

## Results

The calculation of this study uses Continuous SWAT (C-SWAT) with a minimum weight of 0 (W0), with the weight used is 1/3. The C-Swat calculation is used to determine the most influential dimension in respondent preferences. In this study using the Pair-wise-comparison

(PWC) procedure resulted in a value that can be seen in Table 1 below:

**Table 1.** Dimension C-SWAT Score

Dimension	C-SWAT Score
Time Load	33.33
Mental Effort Load	34.67
Psychological Stress Load	42.00

Table 1 above shows that three dimensions are in a fairly high range. The workload category is in 0-9 low category, 10-29 moderate category, 30-49 moderately high category, 50-79 high category, 80-100 very high category (Hakim et al., 2018). Psychological stress effort is a burden with the highest value, namely 42, mental effort has a value of 34.67 while the time load has the smallest value, which is 33.33. Psychological burdens can be influenced by a lack of motivation, lack of references, lack of information and limited support from the existing environment.

In this study, respondents were asked to perform a simple test. Simple test is used to know the load of respondents. Simple tests are carried out by performing arithmetic tests in the form of addition, subtraction, multiplication. Addition, subtraction, multiplication tests are carried out at different levels with a total of 10 questions. The test was carried out twice. This test to know student load while doing online test. Test was held online and time to solve the problem was captured. C-SWAT Score can be shown at Table 2 below:

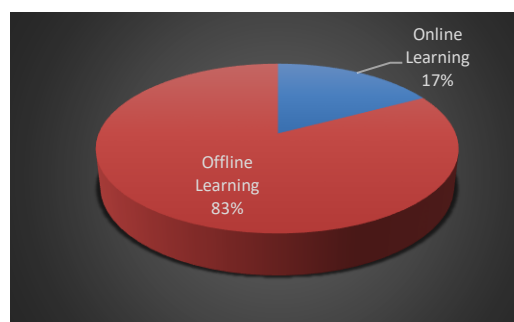
**Table 2.** Dimension C-SWAT Score

	First Operant	Second Operant
Addition	36.71	32.77
Subtraction	36.00	33.60
Multiplication	47.01	40.86

From Table 2 above it can be seen that the first test of addition has a C-SWAT value of 36.71, while the first test on subtraction has the smallest C-SWAT value of 36.00, while the multiplication

value has the highest C-SWAT score of 47.01. The three loads are in the fairly high category. Meanwhile, in the second test, the total C-SWAT score is 32.77, this value is the lowest value than other arithmetic tests. The C-SWAT score is reduced by 33.60, while the multiplication C-SWAT score has the largest value, which is 40.86. The first and second tests show that multiplication has the highest C-SWAT value, this shows that multiplication arithmetic is more difficult than other arithmetic. The score in the first test has a greater value than the score in the second test.

The results showed that the response in general preferred face-to-face learning in class to online learning, this can be seen in Figure 1 below:



**Figure 1.** Learning Method preference.

The picture above shows that as many as 83% of respondents who are students prefer face-to-face learning in class (Offline School). While the remaining 17% prefer online learning. This shows that there is fatigue during online learning which has been carried out for almost two years.

In online learning, respondents prefer learning in real time rather than learning independently and with an unspecified time. This can be seen in Figure 2.

Figure 2 above shows that 81% of respondents prefer synchronous learning. Synchronous learning is structure learning with a determined time and direct explanation by the lecture. Meanwhile, asynchronous learning is learning independently by downloading material and studying it at an unspecified time. Only 19% choose asynchronous learning by of the

respondents. This shows that the interaction in learning is an important role in determining the level of understanding of the respondents during lectures.

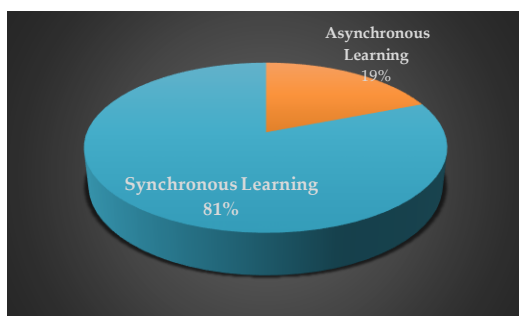


Figure 2. Synchronous and Asynchronous Learning Preference.

During online school there is also an exhaustion. Exhaustion can be emotional and physical. One of them is fatigue. Fatigue can be the main reason leads student poor learning status (Lu and Qi, 2021). There are fatigue during online learning such as sleepy, lack of concentrate, eye strain, neck tension, qualm, hungry, headaches and others. During online learning, student in mechanical engineering education have fatigue complain. Most of student have eyestrain (24.01%) due to high frequency see screen. The second largest complain is sore body 16.46%. The third is sleepy 14.27%.

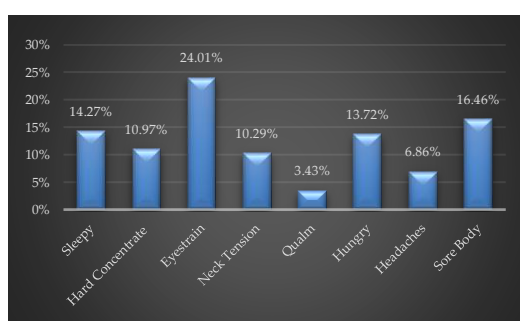


Figure 3. Fatigue during online learning.

In this research, researcher measure learning interest, online learning, and learning achievement correlation. Normality test to know if respondent answer is distribution normal or not. In this research normality test use

Kolmogorov-Smirnov with significant 0.05. From result Table 3 shows that distribution is normal.

Correlation test to know the relation of online learning and student achievement during online school. This test use Pearson Correlation with significant 0.05. From Pearson correlation test correlation learning interest and online learning is 0.69. Correlation learning interest and learning achievement is 0.000. Correlation Online learning and learning achievement is 0.47. It can see in Table 4 below. Online learning is not significant correlate with student learning achievement. Online learning is not significant correlate with learning interest.

Table 3. Normality test.

Parameters	Kolmogorov-Smirnov(a)
Learning Interest	0.002
Online Learning	0.040
Learning Achievement	0.000

Table 4. Correlation test.

	Learning Interest	Online Learning	Learning Achievement
Learning Interest	1.00	0.69	0.00
Online Learning	0.69	1.00	0.47
Learning Achievement	0.00	0.47	1.00

## Discussion

The impact of using high-frequency devices/gadget has an effect on mentality. High frequency using gadget may effect mental burden (stress) to user (Lina et al., 2020). The mental wokload experienced by students was generally due to the workload they have. Workload refers to the intensity refers to the intensity of work assignment which are a source of stress (Shah et al., 2011). Workload is the volume of work that is charged to the workforce both physically and mentally (Mahawati et al., 2021). Perceptions of work incompatibility and a stressful work environment are an indication of an excessive mental workload (Zulfiqar et al., 2017). The mental aspect is the calculation of the workload by considering the mental (psychological) aspect.

The analysis result show student psychology stress load during online is higher than other load. It is indicate that lecture need to more creative to interest student during school time. Measurement of mental workload online learning during pandemic is used to know the load of student.

Beside mental load there is also fatigue. Fatigue when online learning mostly eyestrain. Eyestrain can be caused staring at screen for long time, see gadget/computer screen at room less light and recumbent position. Staring gadget/computer not in good position may effect eyestrain and sore body. Sometimes student learn in bad position, example recumbent, sit sideways.

This research show that online learning is not correlate with learning interest and learning achievement while online school (significant Pearson's test > 0.05). It is also shown that more than half, student want to back offline school. It can be challenge to lecture to interest student during online school if pandemic is not over.

## Conclusion

Online learning may cause mental workload and fatigue. In this research, researcher measure mental workload during online school. Mental workload have three aspect such as time load, mental effort, and psychology stress effort. Psychology stress effort is the highest score on C-SWAT. It means student already bore, stress after more than a year online school. That also proven, 83 percentage student mostly want to offline learning like used to before pandemic. While online learning, student have fatigue. Most of them feel eyestrain (24.01%), sore body (16.46%) and sleepy (14.27%). It shows that student use gadget and computer in high frequency and not exercise. To avoid worse fatigue during online school, student is recommended to do exercise and blended learning. Exercise can be done at home such as stretching, yoga other. Blended learning can be done at college for selected major, or discussion, or group assignment.

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