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ANALYSIS OF STUDENT MENTAL WORKLOAD USING NASA TASK LOAD INDEX (NASA-TLX) METHOD

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Abstract---*The growth number of students is a potential for progress in an area. But often, the workload felt by students is above their limits. It can cause a decrease in student performance due to excessive mental workload. One of the learning methods that is applied in almost every campus is e-learning. This study aims to analyze the level of workload at a university based on the measurement of mental load, especially when working in e-learning platform. The method used is to measure the mental workload with the NASA Task Load Index (NASA-TLX) method. The study was conducted on 40 students. Based on the results of the study, the NASA-TLX score obtained was 65. This indicates that the level of mental burden perceived by students is moderate.*

Keywords---*Mental Workload, NASA-TLX, Fatique, Student*

I. INTRODUCTION

According to [1], education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have spiritual spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, the community, nation and state. For this reason, educational activities are the responsibility of all components in it so that the learning process runs smoothly.

One level of education that can be pursued by the community is undergraduate education, where one component involved is student education. The number of students in Indonesia in 2015 reached 5.896.419 people, equivalent to 2.28% of Indonesia's population [2]. The number of students in the province of West Java in 2015, ranked the third highest in Indonesia, amount to 711.461 people, below DKI Jakarta and East Java. Increased by 6.3% from the previous year.

The growth in the number of students is a potential for progress in an area. But often the workload felt by students is above their limits. Even though a high workload will reduce motivation can cause work and performance declines [3], [4] and [5] Meanwhile according to [6], stress that is not managed properly will reduce the level of motivation which will reduce performance. This is the basis of research and is the concern of an educational designer, namely how to design workloads that are optimal and appropriate based on the results of student mental load measurements.

II. LITERATURE REVIEW

Definition of Education

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According to Law [1], regarding the national education system, education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, as well as the skills needed by himself, society, nation and state.

While national education is education based on Pancasila and the 1945 Constitution of the Republic of Indonesia which is rooted in religious values, Indonesian national culture and responsive to the demands of changing times. The national education system is an overall component of education that is interrelated in an integrated manner to achieve the goals of national education.

Workload

According to [7], workload is a group or a number of activities that must be carried out by an organizational unit and is the product of work volume and normal time. Specifically, workload can be divided into two, namely physical and mental workload. The physical burden tends to the burden received by an employee in a job related to his physiological condition. If such work conditions are bad enough, there will be work stress with physical symptoms, such as high blood pressure, diarrhea, obstruction, etc. [8]. According to [9] workload is a source of employee stress.

Workload problems are multidimensional problems [10] and [11], therefore one of the measurements of workload is NASA-TLX which measures several dimensions designed to determine the workload while performing a task or immediately afterwards [12].

III. METHODOLOGY

The study was conducted by means of an experiment. Measurement of mental workload was carried out on Industrial Engineering students in 4th semester of the 2019/2020 odd school year. Samples were taken as many as 40 people. Participants carried out this experiment independently at their home. The task given is closely related to the mental workload in working on e-learning activities. The practical task is to measure the level of mental workload independently after working on online college activities for 30 minutes. Measurement of mental workload is done by filling out the NASA-TLX form. The data collection has several steps. That is:

1. Giving a subjective score from 0 to 100 for the indicators on NASA TLX. Namely the mental effort of the work (Mental Demand), the physical effort of the work (Physical Demand), the pressure associated with the time to do work (Temporal Demand), the level of success (Performance), anxiety, feelings of depression, and stress felt in carry out work (Frustation), the amount of mental and physical work needed in completing work (Effort).
2. Weighting the indicators on NASA TLX. This is by comparing which indicator score is greater.
3. Calculate the average score. By multiplying the indicator score by weight. The multiplication results are then divided into 15. The average score formula = (Rating x Weight) / 15

The data collection results are then processed by averaging the NASA TLX scores obtained from the student participants. The next process is to determine whether the mental load category of students is included in the category of mild, moderate, or heavy based on the results of the NASA-TLX score. The NASA-TLX evaluation criteria according to Hancock and Meshkati in [9] are:

A score of > 80 indicates a heavy workload

A score of 50 - 80 indicates a moderate workload

A score of < 50 indicates a light workload

IV. DATA COLLECTION

There are steps in taking data and processing data. That is:

1. Giving a subjective score from 0 to 100 for the indicators on NASA TLX. After carrying out working on online learning activities for 30 minutes, participants gave a Score. Score results of several indicators can be seen in Table 1.

Table 1. Score of NASA-TLX indicators

Rating Score	
Kategori	*Score*
MD	80
PD	50
TD	60
OP	45
FR	70
EF	85

2. Weighting the indicators on NASA TLX. The results of the NASA-TLX weighting process can be seen in Table 2.

Table 2. NASA-TLX Weighting

NASA TLX Weighting						
	MD	*PD*	*TD*	*OP*	*FR*	*EF*
MD		*MD*	*MD*	*MD*	*MD*	*EF*
PD			*TD*	*PD*	*FR*	*EF*
TD				*TD*	*FR*	*EF*
OP					*FR*	*EF*
FR						*EF*

EF

3. Calculate the average score, by multiplying the indicator value by weight. The multiplication results are then divided by 15. The average score formula = (Rating x Weight) / 15

Average Score = Sum (Score ×Weight) / 15
= 1125 / 15
= 75

Table 3. NASA-TLX Score Calculation

Kategori	*Score*	*Weight*	*Score x Weight*
MD	80	4	320
PD	50	1	50
TD	60	2	120
OP	45	0	0
FR	70	3	210
EF	85	5	425
SUM	390	15	1125

V. RESULT AND DISCUSSION

The results of recapitulation of data collection and processing can be seen in Table 4. Overall, the mental workload felt by students was moderate, because the NASA-TLX score was 65, included in the range of 50-80. This indicates that the workload given to students is within their limits.

Table 4. Recapitulation of NASA-TLX Score Results

Participant No.	NASA-TLX Score	Participant No.	NASA-TLX Score
1	71	21	62
2	83	22	38.67
3	70.33	23	38.33

4	71	24	61.33
5	67	25	34
6	74	26	66.93
7	66.3	27	65
8	65.3	28	59.33
9	73.3	29	67
10	75.44	30	56.87
11	78	31	46.47
12	81.87	32	55
13	79	33	52.66
14	75.07	34	52.66
15	76.4	35	47.27
16	75	36	60.67
17	69.67	37	51.4
18	78.33	38	71
19	71	39	81.67
20	59.67	40	71
Average	65.00		

Although the average NASA TLX score is 65, it can be said that the workload placed on students is moderate. But, there were two students or equivalent to 5% of the number of samples taken experiencing a high workload, namely Participant No. 12 at 81.87 and Participant No. 39 which amounted to 81.67. This can cause fatigue. According to [14], work fatigue will reduce performance and increase the error rate. In addition, work environment problems can also have an impact on fatigue [15]. To overcome fatigue, one of them is by shortening working hours [16], so it is recommended to rest.

VI. CONCLUSION

Based on the results of the study, the mental workload felt by students especially in e-learning methods is moderate. Where students study according to their limits. Measurement of student mental workload measurement give us insight into that fatigue not only will cause performance student in learning decreased but also student make an error during their study.

NASA TLX is one of powerful method to analyze student strengths and weaknesses in learning something. Besides that, NASA TLX provide information what should we do to overcome fatigue.

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