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Nasa-TLX and Sofi Methods as a Tool for Measuring Students' Mental Load and Failure During Online Learning Basic Neurology Physiotherapy Courses

Ida Aryani Pasaribu[1]*, Yeni Vera[2], Sulaiman[3], Ruri Aditya Sari[4]

[1,2,3] Program Studi Fisioterapi Sekolah Tinggi Ilmu Kesehatan Siti Hajar, Medan, Indonesia

[4] Program Studi Bisnis Digital Politeknik LP3I Medan, Medan Indonesia

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ABSTRACT

Online lectures are currently being implemented due to the Covid-19 Pandemic. The problem of students who are not accustomed to the demands of independent study due to limited time, facilities, materials and abilities, causes excessive anxiety and panic. This will cause a mental burden that it has an impact on student fatigue which causes a decrease in efficiency, resilience and work capacity. Therefore, this study aims to evaluate the mental workload and fatigue of students during online lectures. Measurement of mental workload using the NASA-TLX method and fatigue measurement using SOFI. The results of this study indicate that the mental workload received by students is in the high category while fatigue is in the medium category. Significant differences in average mental load can be seen based on gender, scientific field, study program accreditation, education level, GPA during online lectures, involvement of student activities, online lecture aids, online lecture venues, how to connect to the network, online tuition fees, and the number of hours of online study. Significant differences in average fatigue can be seen based on gender, study program accreditation, education level, online lecture aids, and the number of hours of online study.

Corresponding Author:

Ida Aryani Pasaribu
Program Studi Fisioterapi
Sekolah Tinggi Ilmu Kesehatan Siti Hajar, Medan, Indonesia
Email: alfi.lailikusuma@gmail.com

INTRODUCTION

The COVID-19 pandemic has had a major impact on any sector, starting from the social, economic and education sectors. The spread of the virus is very fast because of the mobility of people between countries. The characteristics of this virus are indeed very fast and continue to spread in the human population. The number of people infected with Covid-19 has always been a significant increase every day since the emergence of the virus in the city of Wuhan. Until exactly in March 2020, Indonesian president Joko Widodo announced that for the first time the Covid-19 virus appeared in Indonesia. The government was very quick to take policies that were put in place when the Covid-19 virus spread in Indonesia. The Indonesian government at that time took a policy of implementing PSBB (Large-Scale Social Restrictions), namely by providing socialization in the health sector such

as providing education regarding the importance of maintaining personal hygiene, physical restrictions in the sense of reducing the mobility of associations with the community which caused all activities to be carried out only in public areas. home only. Starting with working from home, the change in learning styles for students and students, which was originally carried out face-to-face (offline), becomes learning from home (online).

Online lectures are a learning system through electronic media that is connected to the internet network. In the online lecture system, the lecturer as a presenter will explain and provide direction and provide a stimulus for students so that students are able to understand the material properly and correctly. The demand for self-study at home online does not differentiate the type of assignment given. In addition to individual assignments, lecturers often give group assignments, which to complete the task requires intense discussion with fellow group members. The limited number of quotas and signals causes students to delay work so that assignments will pile up and cause boredom to stare at electronic media screens. Online courses also do not distinguish the type or nature of courses such as qualitative, quantitative, and even practical courses. Then for the duration of lectures for each type of subject, the lectures are carried out the same as face-to-face lectures, so students must continue to use electronic media such as smartphones or laptops or computers during the lecture process. So at this time students have to stare at electronic media screens during lectures and also during assignments. Meanwhile, according to The American Academy of Pediatrics screen time for adults should be given a consistent time limit that does not use sleep and activities that are important for health.

The rays emitted by electronic media screens for a long duration can cause fatigue for students both physically and mentally. In addition, when viewed from the human factor, when students conduct online lecture activities they will think a lot about the information obtained (cognitive processes). This human thought process stimulates human performance to work optimally. So that this cognitive function can be used as a basis for measuring the safety of the work environment with the existing workload [1]. Thus, it can be identified that the source of the student's mental workload comes from an imbalance between the demands of the tasks given to the abilities and time possessed by the students, causing excessive anxiety and panic. This will cause a mental burden so that it has an impact on student fatigue which causes a decrease in efficiency, resilience and work capacity.

METHOD

Exhaustion

Fatigue is a condition that can be felt by a person which can be characterized by a decrease in endurance, decreased concentration levels, decreased appetit,e and can cause the body to become weak.(Oktaviara, 2021) Work fatigue is a subjective feeling accompanied by a decrease in efficiency and the need for work. Fatigue is a decrease in the ability to work physically or mentally, or a subjective feeling that a person can no longer do his job, and is a function of lack of sleep, changes in circadian rhythm and time on duty. A decrease in capability caused by a physiological load or a psychological burden can ultimately prevent a person from being able to perform their functions within normal limits, so that it can affect performance efficiency or work performance, which can result in a decrease in alertness and a decrease in work productivity. Fatigue is a condition characterized by a feeling of tiredness that is influenced by physical and mental conditions and can reduce endurance. Work fatigue is a subjective feeling accompanied by a decrease in efficiency and the need to work [2]. Fatigue is defined as a feeling of tiredness, a dislike for doing an activity and a reluctance to continue it or also defined as a decrease in the ability to complete a job and a biological drive to recover [3]. Basically, when fatigue is experienced, it can be easily overcome through rest or sleep, but often a person is faced with situations that do not allow him to get enough rest, and in the long run it can have an impact on his safety and health.

Mental Workload

In addition to physical burden, mental burden must also be assessed. But assessing mental workload is not as easy as assessing physical workload. Mental work is difficult to measure through changes in body functions. Physiologically, mental activity is considered an easy job, so the calories needed for mental activity are also low [4]. Even in terms of morality and responsibility, mental activity is clearly heavier than physical activity, because the operating system involves more brain work (white collar) than muscle work (blue collar). Today mental activity is dominated by office workers, supervisors and leaders as decision makers with greater responsibility, workers in information engineering, workers using high technology, jobs with high preparedness, monotonous work, etc. Every mental activity will always involve perception, interpretation of the information received by the senses and elements of mental processes to make decisions or processes to remember past information [5]. The problem in humans is the ability to remember or remember stored information. The process of remembering the elderly is especially problematic because most elderly people experience a decline in the ability to remember.

Mental workload is also the difference between the maximum mental load capacity of the person and the workload or task. A person can handle psychological workload in a job according to the following conditions: (a) Type of activity and work situation (b) Response time and available completion time (c) Individual factors such as level of motivation, expertise, fatigue/saturation (d) Tolerance allowable performance

Nasa-TLX

National Aeronautics and Space Administration Task Load Index (NASA-TLX) method is a method of subjectively measuring workloads based on an average load of 6 dimension scale, namely Mental Demand, Temporal Demand, Physical Demand, Effort, Performance, and Frustration [6]. The subjective mental workload gauge NASA-TLX has several advantages, namely multidimensional measurement, fast and simple in the process of presenting data and low research costs, besides the NASA-TLX method is the best when compared to the SWAT method and the RSME method, and NASA-TLX can be used to measure mental workload in a manufacturing or service company.

The steps for measuring mental workload with the NASA-TLX method:

1. Giving Rating

In the measurement, the rating is calculated from a questionnaire with 6-dimensional scales of mental workload with a range of values (0-100).

2. Weight (Weight)

In measuring the weight of the questionnaire, it is given in the form of a comparison consisting of 15 pairs.

3. Calculating the Mean Weight Workload

To find out the Mean Weight Workload (MWW) of the NASA-TLX questionnaire, it is done by multiplying the weight and rating of each dimension and then adding up, then to find out the total workload divided by 15.

4. Determine the Mental Workload Score Category

Based on the score obtained from the calculation of the Mean Weight Workload (MWW) the mental workload is divided into 5 categories. The level of these categories can be seen in table 1.

Table-1. Mental Workload Score Category

No	*Range*	Mental Workload Score Category
1	0 – 9	Very low
2	10 – 29	Low
3	30 – 49	Average
4	50 – 79	High
5	80 – 100	Very High

Swedish Occupational Fatique Inventory(SOFI)

SOFI is a tool used to identify the factors that cause fatigue during subjective work activities. SOFI was first developed by Ahsberg in 1998. SOFI was developed by taking into account several indicators, each of which has 5 questions (multidimensional). The five dimensions of SOFI are sleepiness, physical discomfort, lack of motivation, lack of energy, and physical exertion [7]. Each dimension is described in 25 questions. Each subject was asked to provide a subjective self-assessment on a scale of 0 to 6. A scale of 0 means that it is not felt while a scale of 6 means that it is very felt. To find out which statement has the highest level, the rating with the submaximum level is ranked. Dimension of SOFI method described in table 2.

Table 2. Dimensions of SOFI Method

Dimensi	**Poin**
LacLack Of Energy (LOE)	Overworked
	Worn Out
	Exhausted
	Spent
Physical Excertion (PE)	Drained
	Sweaty
	Palpilation
	Warm
	Out Of Breath
Physical Discomfort (PD)	Tense Muscles
	Stiff Joints
	Numbness
	Hurting
	Aching
Lack Of Motivation (LOM)	Uninterested
	Passive
	Listless
	Indifferent
	Lack Of Concern
Sleepines (SLP)	Sleepy
	Falling a sleep
	Drowsy
	Yawning
	Lazy

source: Oktaviara [8]

The steps used to process the SOFI method are as follows

a. Calculate the average of each dimension b.

b. Calculating the total average

c. Interpretation of score scores

After calculating using the SOFI method, it is possible to analyze the fatigue experienced by students. In this method, facilitates the classification of fatigue types, it can be seen based on the classification of the fatigue rating of the SOFI method.

The research method used includes two stages, namely the data collection stage and the data processing stage.

Data Collection Stage

The data collected in this research includes two types of data, namely:

a. Primary data is data obtained through interviews and distribution of the NASA-TLX workload questionnaire and SOFI questionnaire
b. Secondary Data Secondary data was obtained from the literature and sources of information related to the research conducted.

Data Processing Stage

Processed data is the result of distributing questionnaires that have been filled out by students. Data processing stages include:
a. Data processing of NASA-TLX workload questionnaires and SOFI questionnaires
b. Processing of employee performance questionnaire data includes validity and reliability tests using SPSS16.0 software.
c. Test the significance of workload on performance by using a statistical test with the Chi Square method.

RESULTS AND DISCUSSION

NASA-TLX and SOFI Data

Workload data collection was carried out using the NASA-TLX questionnaire sheet which consisted of 2 parts, namely the rating scale section and the weight section. The assessment category for the SOFI method is shown in table 3. The initial stage is giving a rating (rating scale) assessed with a range (0-100). Respondents were asked to give scores on 6 dimensions of mental workload, namely Mental Needs (KM), Physical Needs (KF), Time Needs (KW), Performance (K), Business Level (TU), and Frustration Level (TF). In the next stage by using a weighted questionnaire, the questionnaire is given in the form of a comparison consisting of 15 pairs, and then the Mean Weight Workload (MWW) will be determined. The NASA-TLX results are as in table 4.

Table-3. NASA-TLX . Questionnaire Processing Results

No	Respondent Code	Dimension						Score MWW	Category Workload
		KM	KF	KW	K	TU	TF		
1	A1	225	0	100	325	320	10	65	High
2	A2	225	30	135	350	195	0	62	High
3	A3	90	0	135	375	140	5	50	Average
4	A4	100	50	100	200	250	50	50	High
5	B1	140	50	320	340	280	0	75	High
6	B2	150	55	210	400	280	0	73	High
7	B3	70	100	350	260	195	0	65	High
8	C1	170	45	200	320	380	0	74	High
9	C2	40	90	110	200	350	40	55	High
10	C3	180	85	240	320	0	400	82	Very High
11	C4	400	120	160	240	240	0	77	High
12	C5	240	280	50	100	45	150	58	High
13	C6	45	135	180	225	180	0	51	High
14	C7	240	45	150	300	450	0	79	High
15	D1	240	75	150	375	280	0	75	High
16	D2	180	75	180	30	425	50	63	High
17	D3	160	170	180	425	170	180	86	Very High
18	D4	0	170	150	270	300	280	78	High
19	D5	195	100	225	375	150	0	70	High
20	D6	65	240	120	275	220	0	61	High
21	D7	160	170	225	90	400	0	70	High
22	D8	325	260	0	65	130	195	65	High
23	D9	140	85	225	285	450	25	81	Very High
24	D10	75	140	75	425	360	120	80	High
25	D11	140	300	180	120	80	0	55	High

No	Respondent Code	Dimension KM	KF	KW	K	TU	TF	Score MWW	Category Workload
26	D12	225	90	90	90	180	0	45	Average
27	E1	150	20	360	180	475	0	79	High
28	E2	75	135	150	225	400	0	66	High
29	E3	130	70	240	280	350	0	71	High
30	E4	375	0	180	160	225	40	65	High
31	E5	220	55	80	160	200	0	48	Average
32	F1	180	0	350	280	100	140	70	High
33	F2	80	90	130	240	200	135	58	High
34	F3	180	5	450	320	240	0	80	High
35	F4	240	0	150	280	400	45	74	High
36	F5	180	0	350	280	45	210	71	High
37	F6	50	100	50	200	250	100	50	High
38	F7	90	45	240	240	280	0	60	High

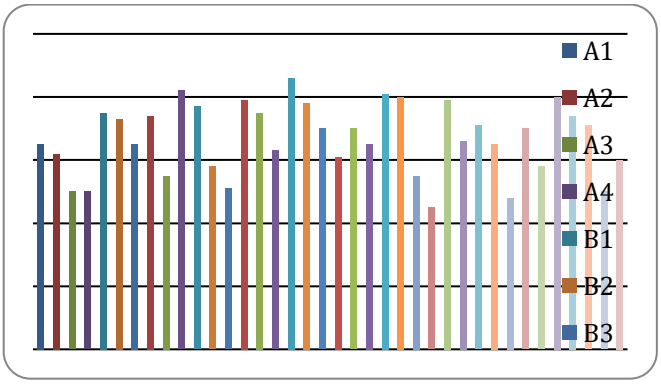

Figure 1. Nasa-TLX . Final Score Results

Figure 1 showed, the difference in scores between one student and another. The difference in scores occurs because the assessment made using the NASA TLX method is subjective depending on the perception of each respondent. When viewed from the aspect of NASA TLX, there are 6 dimensions, namely Physical Demand that students experience workloads that are at a moderate to very high level because of lecture activities such as typing assignments given by lecturers via google classroom links and e-learning. Then on Mental Demand, students experience a workload that is in the high to very high range because considering the deadline given by the lecturer is relatively fast so they are motivated to complete lectures, while if the task is not done, students will not be able to join in the next lecture. Own Performance students feel that the work given by the lecturer is not optimal because there are opportunities to plagiarize other tasks so that this workload is considered low to high. Meanwhile, frustrated students experience frustration because each lecturer gives many assignments so that the tasks pile up. In terms of effort, students experience extraordinary efforts with high to very high workloads.

Table-4. SOFI Questionnaire Processing Results

No	Code Respondent	Dimension LOE	PE	PD	LOM	SLP	Score SOFI	Fatigue Category
1	A1	0.00	0.33	0.67	1.00	0.33	0.47	High
2	A2	0.67	1.33	1.67	1.00	1.67	1.27	High
3	A3	0.67	0.00	0.33	1.00	1.67	0.73	Average
4	A4	0.00	1.33	0.33	0.33	1.67	0.73	High
5	B1	0.00	1.33	1.33	0.00	0.00	0.53	High
6	B2	0.33	0.67	1.00	1.00	0.00	0.60	High
7	B3	0.67	0.67	0.67	0.67	1.00	0.73	High
8	C1	0.33	0.33	0.00	1.33	0.00	0.40	High

No	Code Respondent	Dimension LOE	PE	PD	LOM	SLP	Score SOFI	Fatigue Category
9	C2	0.33	1.67	1.00	0.00	0.00	0.60	High
10	C3							Very
		0.00	1.33	1.67	0.00	0.33	0.67	High
11	C4	0.33	1.67	1.33	1.33	0.67	1.07	High
12	C5	1.33	1.67	0.00	1.00	0.33	0.87	High
13	C6	1.67	1.33	1.33	1.33	0.00	1.13	High
14	C7	0.67	0.33	0.00	1.67	0.33	0.60	High
15	D1	1.33	1.67	1.67	0.00	0.00	0.93	High
16	D2	0.67	1.67	0.00	0.00	0.33	0.53	High
17	D3							Very
		1.67	1.67	0.00	1.33	0.33	1.00	High
18	D4	0.00	0.00	0.33	0.67	0.33	0.27	High
19	D5	1.33	1.33	1.33	0.33	0.00	0.87	High
20	D6	0.33	1.00	1.33	1.00	1.67	1.07	High
21	D7	1.33	1.67	1.00	1.33	0.33	1.13	High
22	D8	0.00	0.00	1.00	0.00	1.33	0.47	High
23	D9							Very
		0.00	1.67	0.33	1.33	0.33	0.73	High
24	D10	0.00	1.67	1.67	0.67	1.67	1.13	High
25	D11	0.00	0.00	0.33	1.00	1.00	0.47	High
26	D12	0.67	0.67	1.33	1.00	0.67	0.87	Average
27	E1	1.33	1.33	0.67	1.67	0.33	1.07	High
28	E2	1.67	1.67	0.33	1.00	1.33	1.20	High
29	E3	0.33	1.33	1.00	0.00	0.67	0.67	High
30	E4	0.33	0.67	1.33	0.33	1.00	0.73	High
31	E5	0.67	1.67	1.33	1.33	1.33	1.27	Average
32	F1	1.33	0.00	0.33	0.00	0.33	0.40	High
33	F2	0.67	1.00	0.33	1.33	1.33	0.93	High
34	F3	0.33	0.67	1.33	1.00	0.00	0.67	High
35	F4	1.33	1.00	0.33	1.33	0.67	0.93	High
36	F5	1.33	1.67	1.67	1.00	1.33	1.40	High
37	F6	1.67	0.33	1.33	1.33	0.00	0.93	High
38	F7	0.00	0.67	0.00	0.33	1.00	0.40	High

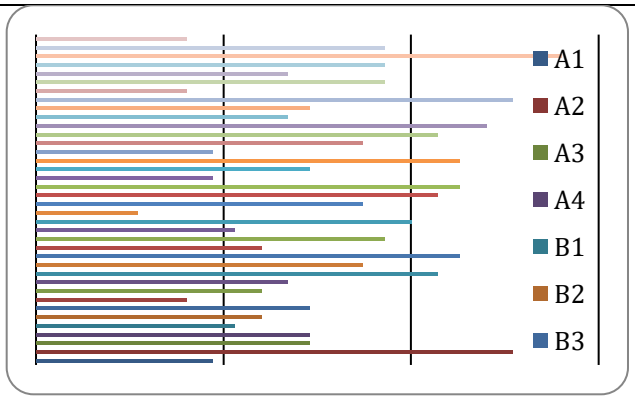

Figure 2. Sofi's Final Score Results

Based on the SOFI questionnaire from 38 students, the results of the fatigue level were 0% in the low category, 78% in the medium category and 22% in the high category. Thus, it can be concluded that based on the SOFI questionnaire, the students' fatigue level is in the medium category. Based on the results of the SOFI dimension, it can be seen that the dimension with the highest total value is physical discomfort, then sleepiness, and lack of motivation.

Students' physical discomfort in online learning often occurs due to musculoskeletal disorders. Lack of energy must occur if students have received complaints of musculoskeletal disorders. Meanwhile, for sleepiness, students tend to be sleepy because online learning is considered by the lecturer to teach in one direction which makes students sleepy and less motivated.

Based on the results and discussions that have been described, it can be concluded that students who do online learning experience fatigue, which is categorized in moderate fatigue with the average total fatigue value obtained is 1.284. The results of the SOFI questionnaire on 4 dimensions of fatigue, namely: lack of energy (lack of energy), physical exertion (exert physical exertion), physical discomfort (physical discomfort) and sleepiness (drowsiness) are in the range of moderate values. students feel complaints on several limbs, the part of the body that workers complain the most is the lower limb, namely the right calf with a percentage of complaints of 21% and the left calf as much as 20%.

The improvements made are as follows:

Based on the results of the study, students experienced physical discomfort such as pain, cramps, joint stiffness, and muscle tension due to a bent work posture. Students have complaints of neck pain. If this happens continuously, it can lead to musculoskeletal disorders (MSDs), while the solutions that can be done by students are:

Exercise regularly, and take part in the QHSSE Fitness Challenge program.

a. Performing ergonomics exercises and relaxation/neck stretching movements such as head drops, shoulder blade squeeze, prone extension, etc. in between lectures.
b. Students can carry out regular health checks at the company clinic and join the Fit to Work program
c. Work fatigue can be overcome by taking adequate rest, eating nutritious food, exercising (following the QHSSE Fitness Challenge program), doing ergonomic exercises/neck stretching movements such as head drops, shoulder blade squeeze, prone extension, etc., as well as adequate sleep duration. The high mental workload can be overcome by adjusting the workload with student abilities, giving rewards and employee motivation. Companies can conduct socialization or training about the importance of mental workload & fatigue awareness, maximize safety talk/P5M, and adjust roster shifts.
d. Students can do Power Naps, which is a short nap for 30-45 minutes before work, this is considered to increase one's awareness.
e. Maintain a normal sleep pattern of 7-9 hours per day.
f. Students have a high need for time, this is related to repetitive work, students can take advantage of waiting time and prayer breaks to rest
g. Students have high physical needs because they work with physical activity continuously.
h. Students need high concentration, focus, and vision in learning. Students can relax for a while learning to control boredom. Lecturers can give rewards to students to increase learning motivation

Onyema [9] indicated that the prolonged presence of COVID-19 could threaten the right to education, with school closures causing serious problems for parents, and the community, in addition, could have an impact on academic interest. Psychologically, work uses mental activity as a job that is not strenuous so that it does not require high calories. Mental activity is more strenuous than physical activity, because in carrying out mental activity, work uses the brain more than muscle [10]. Online learning is a learning system using learning media with an internet connection that requires preparation such as communication tools in the form of cellphones or laptops / PCs and an internet connection. High workloads can cause work fatigue that will decrease productivity [11]. The higher the workload, the higher the work fatigue and vice versa. The mental load effect is not visible directly, but can be observed and monitored at regular intervals [12]. Mental activity is heavier than physical activity because it involves more mental activity than muscle activity. Students complained

a lot about the increasing volume of coursework, tight deadlines, and fatigue staring at screens, difficulty understanding online learning [13] [14] [15].

CONCLUSION

The results of this study indicate that the mental workload received by students is in the high category while fatigue is in the medium category. Significant differences in average mental load can be seen based on gender, scientific field, study program accreditation, education level, GPA during online lectures, involvement of student activities, online lecture aids, online lecture venues, how to connect to the network, online tuition fees, and the number of hours of online study. Significant differences in average fatigue can be seen based on gender, study program accreditation, education level, online lecture aids, and number of hours of online study.

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