# Mental workload of undergraduate student (a case study in Industrial Engineering Department of Diponegoro University)

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**Abstract.** High competition in the era of globalization requires repair and improvement over all of the academic community in Indonesia, including the students. This makes the students compete in their studies and potentially cause mental studyload which could have implications for many things. This study aims to determine the level of mental load among the students of the Department of Industrial Engineering Undip in semesters 3 and 5 using the NASA-TLX, with respondents as many as 50 students. In addition, this study try to find out the NASA-TLX's dominant scale perceived by students and trying to prove, whether external factors such as previous semester grade point, study hours per day, entrance selection exam and free-time activities affect the score of mental load or not. The results of the mental study load measurement shows that the average score of mental study load of 80.04 (ponderable). For the dominant scale, the scale is Temporal Demand. Analysis of Variance (ANOVA) for external factors indicate that these factors do not have a significant influence on the existing score of the mental study load.

## 1 Introduction

Basically, human activity can be classified into physical work (muscle) and and mental work (brain). Although it can not be separated, it can still be distinguished between physically dominated work and work dominated by mental activity. This physical and mental activity cause some consequences, namely the emergence of workload. Workload can also be divided into two, namely the physical workload and mental workload.

Mental workload is defined by [1] as the difference between the workload demands of a task and the maximum capacity of a person's mental load in a motivated condition. A similar opinion is also put forward by [2] where the performance or working ability of a worker depends on the comparison between the size of the job demands and the amount of the worker's ability. If the task demand is greater than the employee's ability or capacity, it can cause overstress, fatigue, work accident, injury, pain, illness, and others. If the demands of the task is lower than the ability of workers, it can cause understress, boredom, boredom, and others. This comparison is then known as mental workload. Mental load measurements have long been known in the world of ergonomics, especially cognitive ergonomics. Since

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the emergence of the NASA-TLX method in the 1980s, mental workload has become one of the factors calculated in various aspects relating to productivity and workers themselves.

Industrial Engineering Department as one of the departments at the Faculty of Engineering Diponegoro University also continues to make improvements that not only aims to improve the quality of graduates, but also aims to try to adjust the needs of the rapidly growing manufacturing industry. The preliminary study resulted in the following facts: 73% of respondents had difficulty arranging time between academic activities and activities outside of academics. As many as 69% of respondents have skipped lectures in pursuit of deadlines of laboratory reports or major tasks. As many as 63% of respondents suffered health problems so their daily activities are disrupted and even as many as 83% of respondents experiencing stress in undergoing lectures at this time. Through that preliminary studies, it can be concluded that the amount of academic burden that must be borne proportional to the mental burden that must be faced.

Some studies related this topic have been widely discussed as [4, 5, 6, 7, 8, 9, 10, 11, 12]. However, the specific topic related the mental study load of the student during the practicum and courses have never been discussed in detail. Based on this gap research and the backgrounf, it is necessary to conduct further research to determine the level of mental workload among students of Industrial Engineering Department of Diponegoro University. In addition, to find out the level of mental workload among students of the Department of Industrial Engineering Undip, this study find out and analyze the problems that are dominant perceived, as well. Besides, it find out whether the external factors such as grade point (indeks prestasi/IP) of previous semester, the number of study hours per day, entry point for a person to be a student of the Department of Industrial Engineering Undip until activities in his/her spare time affect the level of mental workload experienced by a person. In this study, NASA-TLX method [3] is used to complete the study aims.

## 2 Literature Review

The NASA-TLX method was developed by Hart of the NASA Ames Research Center and Staveland from San Jose State University in 1981 [3]. This method of was developed based on the emergence of subjective measurement needs that are easier but more sensitive on the measurement of workload. [3] describes the steps in measuring mental workload using the NASA-TLX method, ie:

1. Explanation of mental load indicator to be measured
2. Weighting
3. Rating calculation
4. Product calculation : ***Product = rating x Factor weight***
5. Calculation of Weighted Workload (WWL) : ***WWL = Σ Product***
6. Calculation of mental workload : $score = \frac{\sum(weight\,x\,rating)}{15}$
7. Interpretation of score

There are six indicator of mental workload in NASA-TLX: mental demand (MD), physical demand (PD), temporal demand (TD), performance (OP), Frustation level (FR), Effort (EF).

## 3 Method

The data collection for this research is performed by two stages, namely the design of questionnaire and the distribution. The criteria for this study object are undergraduate student of classes of 2014 and 2015. They are chosen because both of this generation is

active undergraduate students who ever and is undergoing laboratory and project. The number of objects in this study are 50 students, with the provision of random sampling.

Dependent variable in this study is mental workload score, while the independent variables are previous grade point (IP) (2.75-3.00 ; 3.01-3.50 or ≥3.51), the study hour per day (≤1 hour, 1-2 hours, ≥2 hours), entrance point (SNMPTN, SBMPTN or UM), and spare time activities of the students (academic or non academic activities).

Data processing is done using ANOVA and NASA-TLX. The NASA-TLX analysis was performed using a fishbone diagram.

## 4 Result and Discussion

The identification of study load for student in third semester explain that there are about 20 credit (divided into 9 courses and 2 practicum). The study load for the student in fifth semester are about 18 credit (divided into 8 courses and 1 integrated practicum).

Based on the result of data collection, the average score of the mental workload using NASA-TLX is 80.04, while the total score for 50 respondents is 4002. According to the classification of [1], the score is classified as high scale and the work completed is quite heavy. Based on interviews conducted with the respondents, the most commonly reasons of this result related to some causes as seen in Figure 1.

The calculation of the number of each scale is intended to find the dominant scale of NASA-TLX which is felt by students of Industrial Engineering Undip. Details of the sum of each scale can be seen in table 1. From table 1 it can be concluded that the scale with the highest score is Temporal Demand scale and scale with the lowest score is Physical Demand scale.

**Table 1.** Calculation of NASA-TLX scale

| No | Scale | Score | Rank |
|---|---|---|---|
| 1 | Mental Demand | 110 | 4 |
| 2 | Physical Demand | 93 | 6 |
| 3 | Temporal Demand | 160 | 1 |
| 4 | Effort | 150 | 2 |
| 5 | Performance | 141 | 3 |
| 6 | Frustation Level | 96 | 5 |

The next step is analyzing the variance (ANOVA) for external factors with the result sd seen in Table 2.

## 5 Conclusion and Further Studies

The conclusion that can be taken from this study is the level of mental workload that occurred among students of Industrial Engineering Department of Diponegoro University semesters 3 and 5 is 80.04 (high level) high. The dominant scale is the Temporal Demand scale which is related to working time of a task or job as well as the strict deadline of the report.

**Table 2** Result of ANOVA for external factors

| No | External factor | Sub factor | Score range | Mean | Result |
|---|---|---|---|---|---|
| **1** | Previous grade point | 2,75 – 3,00 | 66,00 – 89,33 | 83,65 | Not significant |
| | | 3,01 – 3,50 | 44,00 – 92,00 | 76,85 | |
| | | ≥ 3,50 | 55,33 – 90,67 | 76,30 | |
| **2** | Study hour per day | ≤ 1 hour | 67,00 – 91,33 | 82,60 | Not significant |
| | | 1 – 2 hour | 44,00 – 94,67 | 77,85 | |
| | | ≥ 2 hour | 61,33 – 90,67 | 76,65 | |
| **3** | Entrance selection exam | SNMPTN | 48,67 – 94,00 | 78,40 | Not significant |
| | | SBMPTN | 44,00 – 91,33 | 76,50 | |
| | | UM | 66,00 – 94,67 | 84,95 | |
| **4** | Free-time activities | Academic | 58,67 – 94,00 | 85,15 | Not significant |
| | | Non academic | 44,00 – 94,67 | 81,50 | |

The high score of temporal demand scale is caused by three reasons, namely the timeliness of reports and short tasks, the existence of a practicum with the timing of the concurrent execution and the habit of postponing the work owned by the respondent. For external factors such as previous grade point, study hours per day, entrance selection exam and free-time activities have not significant effect on the mental load score of existing measurement results. However, it does not rule out that the existing mental load score can be influenced by other external factors, which have not been tested statistically. The further studies related to the measurement of mental workload among students are:

1. The level of mental load based on other criteria, such as for students with the final report.
2. The level of mental load in each practicum module

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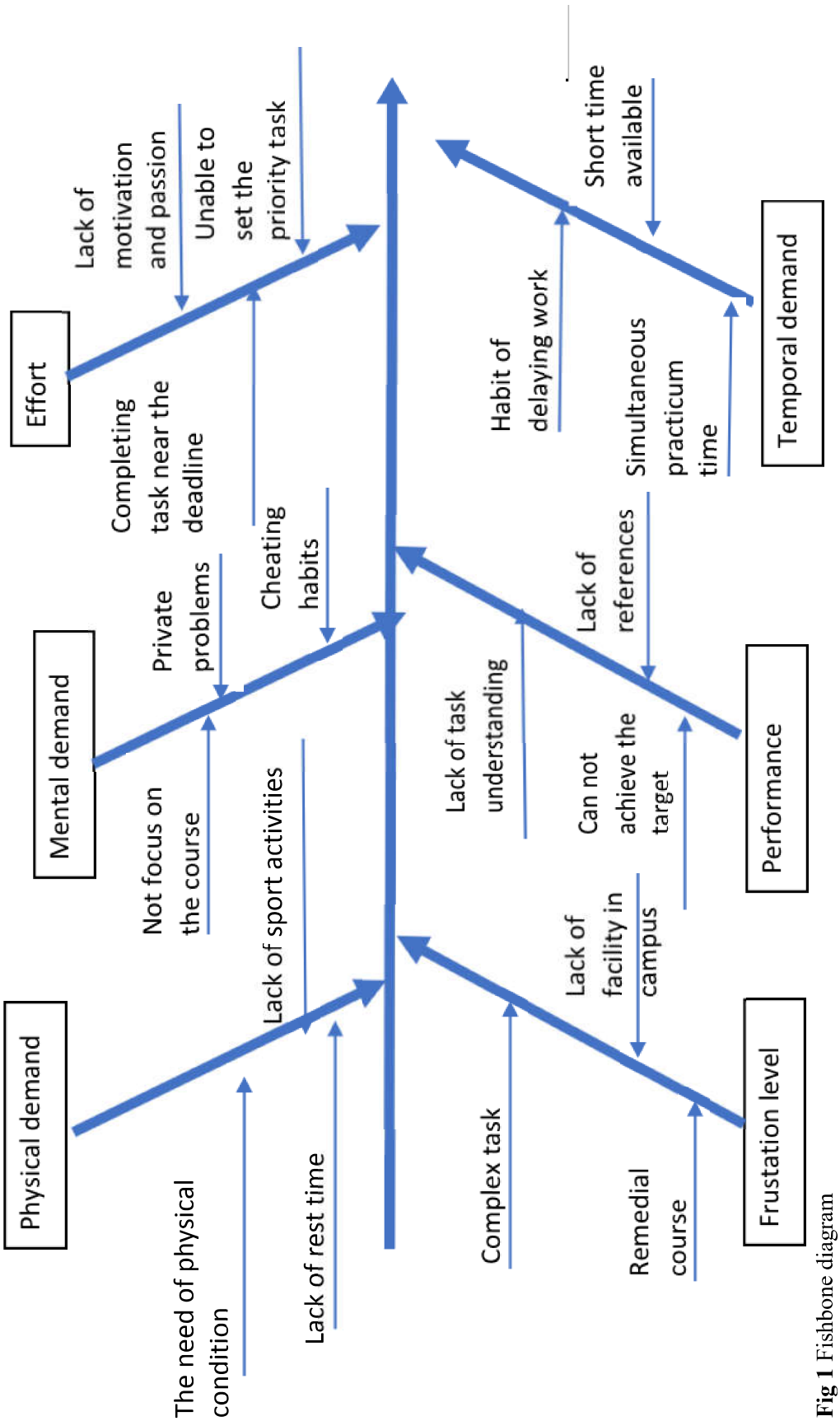


**Fig 1** Fishbone diagram