

# Analyzing Mental Workload Using the Nasa-Tlx Method during Book Reading

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**ABSTRACT:** Work physiology is the study of how the human body adapts and functions in the work environment. The measurement of mental workload serves to determine the psychological pressure of a person in performing a certain activity. This study aims to analyze the mental workload of students when reading a book, in a standing posture. The research activity uses the NASA-TLX method. The research location was conducted on 4 students of the Industrial Engineering Study Program, University of Mataram. The results showed that there were 3 respondents with a workload value between 37-48 which according to the interpretation of the score on mental workload was included in the rather high category, and 1 respondent had a workload with a value of 51.33 which was included in the high category. This means that there is one respondent in the high category who experiences mental disorders when reading in a standing position for 30 minutes, as well as the other three respondents. The NASA-TLX assessment indicators indicate that the respondents experienced dominant pressure on physical (PD), effort (EF), and performance (OP).

**KEYWORDS:** Workload, Students, Mental, NASA-TLX.

## I. INTRODUCTION

Work physiology is the study of how the human body adapts and functions in the work environment [1]. Work physiology involves the study of the body's physiological responses to work-related demands and stress [2, 3]. This understanding is necessary to protect the health and well-being of workers, as well as to improve productivity and work efficiency. Factors such as physical activity, work posture, work environment, and workload can affect the body's physiological responses [4, 5].

One element that determines the success or failure of a job is human resources or labor [6]. The productivity of a workforce has an influence on the success of a job [7]. Job success will increase with

high productivity and vice versa, but human limitations prevent humans from performing these tasks optimally [8]. These limitations include fatigue and stress caused by physical and mental strain [9]. These are factors that reduce motivation and productivity and can also lead to work irregularities, poor judgment, accidents, or injuries [10, 11].

Therefore, it is necessary to understand work physiology and the methods of measuring work physiology, physical energy, and mental energy as a benchmark for improving work procedures. Everything can be measured directly or indirectly [12, 13]. Direct measurement, or measurement carried out using special equipment, shows the amount of energy and oxygen used for each task [14]. Through the use of formulas, indirect measurement determines the amount of energy produced and oxygen used for each task based on information on heart rate per minute, body temperature variations, and experimental recovery time [15].

This study aims to analyze the physiological workload by measuring the mental workload with the activity of reading a book while standing for 30 minutes. The research activity was carried out on students in the Industrial Engineering Study Program, University of Mataram. The method used is NASA-TLX, which is a method that focuses on measuring mental workload using 6 indicators, namely mental, physical, time, performance, effort, and frustration. It is hoped that this research can be a medium to add information related to mental workload and provide considerations for solutions to overcome it.

## II. RESEARCH METHOD

This study aims to analyze the mental workload of students while reading a book in a standing posture. The research involved 4 undergraduate students from the Industrial Engineering Study Program at the University of Mataram. Data collection was conducted by assigning the students, as research subjects, to read a

book for 30 minutes. The reading environment was designed to simulate a typical library setting. The analysis utilized the NASA-TLX method, a tool for measuring mental workload in individuals during specific activities. NASA-TLX calculations focus on 6 indicators: mental demand (MD), physical demand (PD), temporal demand (TD), performance (OP), effort (EF), and frustration (FR). Subsequently, as the final stage, students were given a NASA-TLX questionnaire to fill out. Conclusions were drawn through calculations using the NASA-TLX method. In simple terms, the NASA-TLX analysis consists of 5 stages: weighting, rating, weighted workload (WWL), average WWL, and mental workload categorization. Mental workload categories are low, moderate, somewhat high, high, and very high. Suggestions for improvement can be based on the category indicated in the final calculation for each individual subject.

### III. RESULT AND DISCUSSION WEIGHTING

Respondents were asked to choose the comparison indicators that they felt had more responsibility in causing mental strain in that area. From this questionnaire, each indicator will be calculated the number of indicators that are considered more dominant. The questionnaire results from the comparison of two indicators of BP respondents when reading a book while standing for 30 minutes, which were felt to be more dominant in causing mental workload on the activity from 15 paired indicator comparisons, were found in the OP (own performance) indicator section. The questionnaire results from the comparison of two indicators of AD respondents when reading a book while standing for 30 minutes, which were felt to be more dominant in causing mental workload on the activity from 15 paired indicator comparisons, were found in the PD (physical demand), EF (effort) and FR (frustration) indicator sections.

Table 1. Weighting result from respondent

| Responses | MD | PD | TD | OP | EF | FR | Total |
|-----------|----|----|----|----|----|----|-------|
| BP        | 1  | 4  | 1  | 5  | 2  | 2  | 15    |
| AD        | 0  | 4  | 1  | 2  | 4  | 4  | 15    |
| MF        | 0  | 4  | 2  | 1  | 5  | 3  | 15    |
| RM        | 0  | 5  | 2  | 1  | 3  | 4  | 15    |

The questionnaire results comparing two indicators for respondent MF when reading a book in a standing position for 30 minutes showed that the EF (effort) indicator was perceived as the more dominant contributor to mental workload during the activity from 15 paired indicator comparisons. The questionnaire results comparing two indicators for respondent RM when reading a book in a standing position for 30 minutes showed that the PD (physical demand) indicator was perceived as the

more dominant contributor to mental workload during the activity from 15 paired indicator comparisons.

### RATING VALUE

Respondents filling out a rating questionnaire using a scale of 5-100 based on their perceived mental workload. The results of this rating are presumably presented in Table 2.

Table 2. Rating value result

| Responses | MD | PD | TD | OP | EF | FR |
|-----------|----|----|----|----|----|----|
| BP        | 30 | 45 | 25 | 30 | 50 | 35 |
| AD        | 10 | 60 | 30 | 50 | 80 | 20 |
| MF        | 30 | 60 | 40 | 30 | 50 | 40 |
| RM        | 5  | 40 | 10 | 60 | 85 | 5  |

Table 2 above shows the summarized results of the questionnaire from respondents who were asked to rate the six mental workload

indicators. The ratings given are subjective and depend on the mental workload experienced by each respondent.

## PRODUCT VALUE

Table 3. Product value

| Responses | MD | PD  | TD | OP  | EF  | FR  |
|-----------|----|-----|----|-----|-----|-----|
| BP        | 30 | 180 | 25 | 150 | 100 | 70  |
| AD        | 0  | 240 | 30 | 100 | 320 | 80  |
| MF        | 0  | 240 | 80 | 30  | 250 | 120 |
| RM        | 0  | 200 | 20 | 60  | 255 | 20  |

Table 3 is the result of calculating the product value obtained by multiplying the rating with the weight of each indicator for each respondent, thus

producing 6 product values for 6 indicators for each respondent.

## WEIGHTED WORKLOAD (WWL)

Table 4. WWL Result

| Responses | MD | PD  | TD | OP  | EF  | FR  | Total |
|-----------|----|-----|----|-----|-----|-----|-------|
| BP        | 30 | 180 | 25 | 150 | 100 | 70  | 555   |
| AD        | 0  | 240 | 30 | 100 | 320 | 80  | 770   |
| MF        | 0  | 240 | 80 | 30  | 250 | 120 | 720   |
| RM        | 0  | 200 | 20 | 60  | 255 | 20  | 555   |

The table above shows the calculated values of WWL (weighted workload), which are obtained from the sum of the product values of the six indicators for each respondent.

## AVERAGE VALUE OF WWL

Table 5. Average result of WWL

| Responses | MD | PD    | TD   | OP   | EF    | FR   | Total |
|-----------|----|-------|------|------|-------|------|-------|
| BP        | 2  | 12    | 1.67 | 10   | 6.67  | 4.67 | 37    |
| AD        | 0  | 16    | 2    | 6.67 | 21.33 | 5.33 | 51.33 |
| MF        | 0  | 16    | 5.33 | 2    | 16.67 | 8    | 48    |
| RM        | 0  | 13.33 | 1.33 | 4    | 17    | 1.33 | 37    |

The table above presents the average WWL (weighted workload) results or final values obtained using the NASA-TLX method. This is calculated by dividing the WWL by the total weight value, which

is 15 for each respondent. It was found that respondent 1 had a total score of 37, respondent 2 had a total score of 51.33, respondent 3 had a total score of 48, and respondent 4 had a total score of 37.

## WORKLOAD ASSESSMENT CATEGORIES

Table 6. Mental Workload Values

| Responses | Workload Value | Categories      |
|-----------|----------------|-----------------|
| BP        | 37             | Moderately High |
| AD        | 51.33          | High            |
| MF        | 48             | Moderately High |
| RM        | 37             | Moderately High |

Based on the table above, the calculated results of mental workload assessment for each respondent show that three respondents have a workload score between 37-48, which, according to the interpretation of mental workload scores, falls into the moderately high category. One respondent has a workload score of 51.33, which falls into the high category. This means that one respondent in the high category experienced mental strain while reading in a standing position for 30 minutes, as did the three other respondents in the moderately

high category. These respondents experienced stress or disturbance from their surroundings.

## IV. CONCLUSION

The aim of this study was to analyze the mental workload of students while reading a book. The method used for this analysis was NASA-TLX. The study was conducted with four students from the Industrial Engineering Program at the University of Mataram. Data collection involved assigning students to read a book for 30 minutes in a standing posture. The results showed that three

respondents experienced mental workload in the moderately high category, while one respondent experienced a high mental workload. The NASA-TLX assessment indicators revealed that physical demand (PD) was the most dominant factor felt by the respondents, followed by effort (EF), and performance (OP).

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