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Mental Workload Evaluation For PMM Outbound Student In X University (UNIX) Using NASA-TLX Method

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ABSTRACT

Program Mahasiswa Merdeka (PMM) is one of the MBKM program. This program allows student to study in different university and majors. It was attended by students of Engineering Faculty from UNIX in State and Private University throughout Indonesia. By participating PMM, the student have overload credits because they have to finish double credit from homebased and destination university. This condition affects the burden on students both physically and mentally. This mental burden of students has an impact on student achievement academically, so the mental burden analysis is needed. In this study, an evaluation of the mental workload was carried out using the NASA-TLX approach. The result found that in general 75% of students experienced a very high workload. The percentage of students who take PMM in State University as much as 50% is in the category of high mental workload and 50% is very high category. The percentage of students who take PMM in Private University is 25% in the very high category and 75% is in the high category. From this study, UNIX can have some consideration about providing the brief (*tips and tricks*) before PMM for student mental preparation and choosing the Private University for destination university.

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INTRODUCTION

Merdeka Belajar Kampus Merdeka (MBKM) is one of the policies of the Minister of Education and Culture. Kampus Merdeka is an autonomous and flexible form of learning in higher education so that a learning culture can be created that is innovative, unfettered, and in accordance with student needs (Tohir, 2020). The MBKM program has eight activities in accordance with Permendikbud Number 3 Year 2020 Article 15 paragraph 1, namely Internships, Teaching Assistance in Education Units, Research/Research, Humanitarian Projects, Entrepreneurial Activities, Independent Studies/Projects, Building Villages/Real Work Courses Thematic, and Student Exchange.

One of the MBKM programs that students are interested in is the Pertukaran Mahasiswa Tanah Air Nusantara (PERMATA) which has been implemented since 2014. Figure 1 shows the results of student interest survey form Directorate General of Higher Education survey in 2020

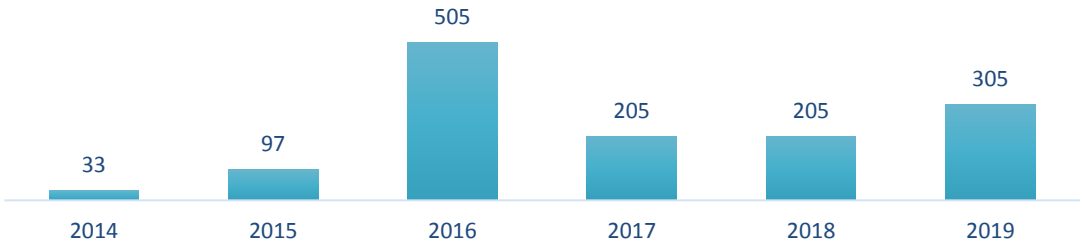


Figure 1. Student interest in the PERMATA program

The PERMATA program has been running since 2014 and continues to improve from year to year. In 2019 the PERMATA program was refined to PERMATA SAKTI due to the use of information technology in the credit transfer system. In 2021, this program was refined again and named the Program Mahasiswa Merdeka (PMM).

PMM is a student exchange from one regional cluster to another that can provide experiences of diversity and a credit transfer system for a maximum of 20 credits (Tim Pertukaran Mahasiswa Merdeka Kemendikbud RI, 2021). In this program, students are given the opportunity to attend lectures at other universities and even other study programs. MBKM provides flexibility for students to be able to take part in the learning process outside of higher education for one to three semesters according to interests outside the study program (Kemendikbud, 2021). From this program, students are expected to have the opportunity to innovate creatively in order to compete with other universities in the ASEAN region. With this policy, it is hoped that universities can develop the quality of education (Haryati, 2012). In addition, the independent learning program is expected to improve the quality of human resources (Baro'ah, 2020).

PMM is implemented in almost all universities in Indonesia, including UNIX. In 2021, there are 66 UNIX students participating in the outbound PMM program. Figure 2 shows the distribution of the number of students in each faculty.

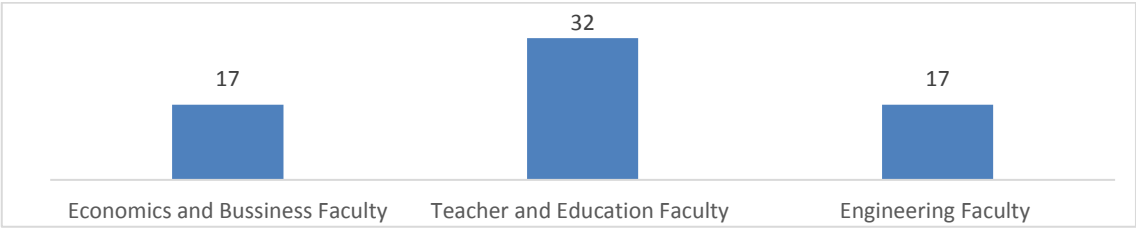


Figure 2. Number of Students of the UNIX PMM Program

The UNIX outbound PMM program requires UNIX students to attend courses at UNIX as the homebased university and at the destination university. This policy makes the workload of students also increase when participating PMM. In addition, the differences in culture both in terms of the learning process, lecturers, and PMM classmate are the challenges for UNIX students. The challenges faced by PMM UNIX outbound students can increase the physical and mental workload. According to Widiasih and Nuha (2018), the physical and mental workload of students must be managed properly so that learning objectives can be achieved optimally. In addition, physical and mental workloads need to be considered so as not to affect productivity in the student learning process (Bilawat, 2019). Mental burdens that are not managed properly can cause psychological problems that will automatically interfere with physical activity (Deasyanti & Muzdalifah, 2021). Any changes or additions to learning patterns, such as the PMM Program, can cause a mental burden among students (Febrilliandika & Nasution, 2020). Therefore, it is necessary to evaluate the mental burden of UNIX outbound PMM students so that the program can run well in accordance with the objectives.

Approach that can be taken to evaluate mental workload is NASA-TLX Questionnaire (National Aeronautics and Space Administration Task Load Index). NASA-TLX was developed based on the need for measurements of mental, physical, time, frustration level, performance, and level of effort. There are

several previous research using NASA-TLX approach. This method used to evaluate the mental workload of train drivers using the NASA-TLX development method, namely RNASA-TLX. The information obtained from this study is that there is a higher mental burden on the afternoon and evening trips for train drivers (Muslimah & Hastuti, 2017). Research using the NASA TLX method was also carried out by Rahajeng at the Yogyakarta Tiki Company. The result is that there is a mental workload between operators so that a proposal for equal distribution of mental load is given (Rahajeng, 2021). Research conducted by Rusindiyanto gave the same result, namely an imbalance in the provision of mental workloads between work divisions at PT. Single Paint Djaja Indah (Rusindiyanto et al., 2016).

The NASA TLX approach is mostly used to measure the workload of operators and employees but there are still few studies that evaluate the mental workload of students using this approach. In addition, the evaluation of the MKBM program, especially the PMM program, has never been carried out. Later, this study can be used as a consideration and corrective for UNIX and other private university.

RESEARCH METHOD

NASA-TLX was first developed by Sandra G. from NASA-Ames Research Center and Lowell E. Staveland in 1981 (Simanjuntak, 2010). In this method there are 6 components that are measured, namely Physical Demand (PD), Mental Demand (MD), Temporal Demand (TD), Performance (P), Effort (U), and Frustration Level (FL). The definition for each component is as follows.

1. Physical Demand (PD) assesses how much this job requires physical activity.
2. Mental Demand (MD) assesses how much this job requires mental and perceptual activity (counting, remembering, comparing, etc.).
3. Temporal Demand (TD) assesses how much time pressure is on this job.
4. Performance (P) measures the level of success in work.
5. Effort (U) measures how much effort is required to complete the job.
6. Frustration Level (TF) measures the level of frustration caused by the work done.

The measurement steps using the NASA-TLX method are as follows (Rusindiyanto et al., 2016). The respondent for this research is the PMM student in 5th semester. The age is about 21-22 years old with male to female ratio is 50:50. The ethical approval are given in this study. It declares in the brief of questionnaire that the data form the respondent will be kept and never be shared to others. The questionnaire is spread of virtually to the Engineering Faculty Student who participated in PMM. The questionnaire consists of two sections. Section A is to collect the weight and section B is to collect the rating.

Weighting

In the weighting stage, 15 combinations of the six factors above are presented. Students are asked to choose which of the two given factors is considered more important or more dominant based on the activities experienced during the PMM activity. The criteria of importance and dominance are subjective based on respondent opinion about their experience and activity. The form of pairwise comparison of the combination of factors is shown in Table 1.

The results of the combination are processed using Expert Choice software which will be calculated based on the pairwise comparison method to determine the weight of each indicator. The total weight for each indicator is 1. The consistency of filling the combination is validated using the inconsistency value obtained from the Expert Choice software, where the inconsistency value should not be more than 10% (Young et al., 2008).

Table 1. Pairwise comparison of NASA-TLX

Indicator	Code	Preference	Indicator	Code
Mental Demand	MD		Physical Demand	PD
Mental Demand	MD		Temporal Demand	TD
Mental Demand	MD		Performance	P
Mental Demand	MD		Effort	E
Mental Demand	MD		Frustration Level	FL
Physical Demand	PD		Temporal Demand	TD
Physical Demand	PD		Performance	P
Physical Demand	PD		Effort	E
Physical Demand	PD		Frustration Level	FL
Temporal Demand	TD		Performance	P
Temporal Demand	TD		Effort	E
Temporal Demand	TD		Frustration Level	FL
Performance	P		Effort	E
Performance	P		Frustration Level	FL
Effort	E		Frustration Level	FL

Rating

At the rating stage, students are asked to give a score from 0-100 to each indicator. There are 6 indicators that must be filled by student. The indicators and questions show in Table 2.

Table 2. The questionnaire section B

Indicator	Question	Rating 0 -100
Mental Demand (MD)	How much mental effort is required for your job?	
Physical Demand (PD)	How much physical effort is required for your job?	
Temporal Demand (TD)	How much pressure do you feel with regard to time to do your job?	
Performance (P)	How much your success rate in doing your job??	
Frustration Level (FL)	How much anxiety, feelings of pressure, and stress do you feel regarding time to do your job?	
Effort (E)	How much physical and mental work is required to complete your work?	

The results of the rating stage are used to determine the average workload (mean weighted workload). The rating classification for each component is shown in Table 3.

Table 3. Classification of workload Value Ratings (Simanjuntak, 2010)

No.	Range	Workload Category
1	0-9	Low
2	10-29	Medium
3	30-49	Quite High
4	50-79	High
5	80-100	Very High

Determination of Weighted Workload (WWL)

WWL is determined by adding up the results of multiplying the weights obtained in step (a) with the rating given in step (b). While the average WWL is obtained from the division of WWL with a total combination of indicators, 15. The classification of the total workload uses the categories in Table 2. The mathematical equation for calculating WWL is as follows.

$$WWL = \sum_{i=1}^{6} \text{rating}_i \times \text{weight}_i \quad (1)$$

$$Average\ WWL = \frac{WWL}{15} \quad (2)$$

The results of this WWL can be used to determine the mental workload of each student, as well as to find out which indicators have the greatest role in determining the mental workload of students during PMM.

The method section structure should: describe the materials used in the study, explain how the materials were prepared for the study, describe the research protocol, explain how measurements were made and what calculations were performed, and state which statistical tests were done to analyze the data. The method must clear with the location and time of the research, the population, and sample of the study, the research variables, and the research data.

RESULTS AND DISCUSSION

In this study, data processing and analysis were carried out for 3 criteria, namely PMM in general, PMM in State University, and PMM in Private University. On the general criteria, respondents filled out a questionnaire based on what they felt when participating in the PMM Outbound program in general, both at Private and State University. PMM at State University respondents filled out a questionnaire based on what they felt when participating in the PMM Outbound program at Private University (PU). Meanwhile, at PMM State University respondents filled out a questionnaire based on what they felt when participating in the PMM Outbound program at the State University (SU). There are 6 indicators assessed on the NASA TLX questionnaire, namely Physical Demand (PD), Mental Demand (MD), Temporal Demand (TD), Performance (P), Effort (U), and Frustration Level (FL). In the NASA TLX method, there are two types of questionnaires that must be filled out by respondents, namely a Level of Importance Questionnaire and a questionnaire about the assessment of the score rating on each indicator.

The questionnaire data on the importance of the respondents were processed using expert choice software to obtain the weight of each criterion. Figure 3 is an example of processing one respondent's data using expert choice software.

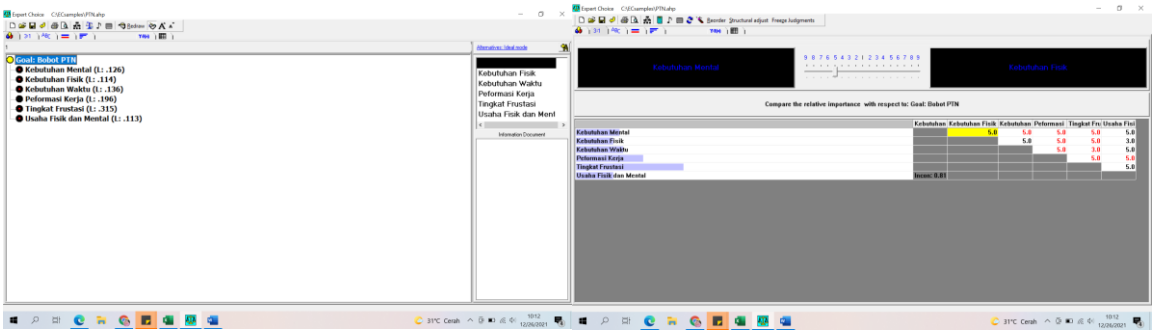


Figure 3. The Example of Data Processing Using Expert Choice Software

Data for all respondents for general criteria, PU, and SU were obtained in Expert Choice. The weight of each criterion is used to obtain the product value, namely the relationship between rating and weight and the weighted workload (WWL) which is the total product value of the six indicators. After obtaining the WWL value, the workload category for each respondent can be determined. There are 5 categories of workload, namely Low, Medium, Quite High, High, and Very High. Table 4 shows the results of the calculation of WWL for PMM in General, PU, and SU.

There is a difference in the number of respondents in PMM Outbound at SU because not all respondents follow PMM Outbound at SU. There are 4 students who take part in PMM Outbound only at PU. From the WWL data and the criteria in Table 4, it can be seen that in general 75% of students experience a high mental workload when participating in PMM Outbound at PU and 25% have a very high mental workload. In PMM Outbound at PTS, 75% of students experience a high mental workload and 25% of students have a very high mental workload. While in PMM Outbound at SU, 50% of students experience a high mental workload and the remaining 50% experience a very high mental workload. Figure 4 shows the percentage of students' mental workload when taking PMM.

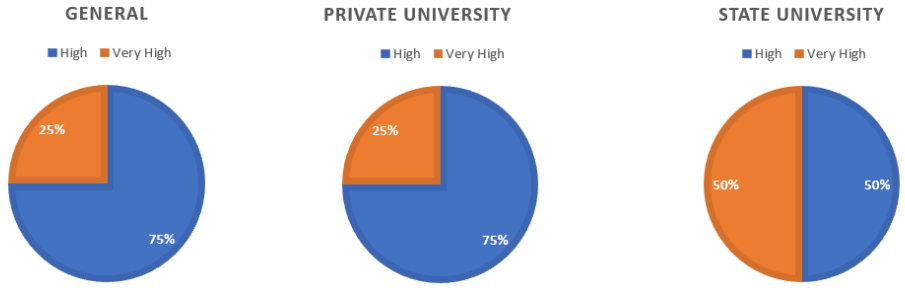
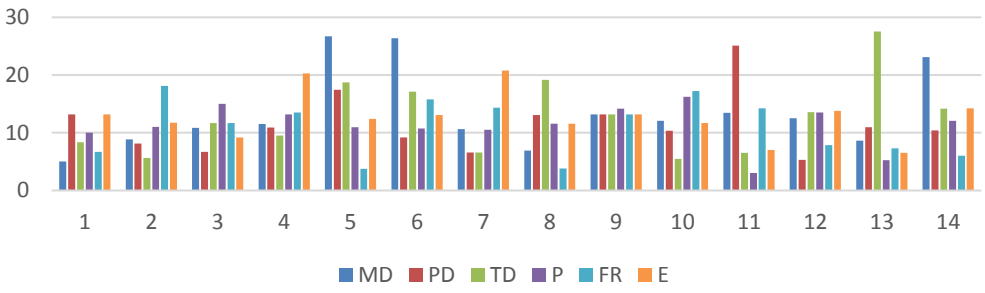


Figure 4. Percentage of mental workload

Table 4. WWL and the categories of PMM in general, PU, and SU

Respondent	General		Private University (PU)		State University (SU)	
	WWL	Category	WWL	Category	WWL	Category
1	63.49	High	66.355	High	63.895	High
2	80.16	Very High	80.16	Very High	81.329	Very High
3	90.045	Very High	84.944	Very High	93.714	Very High
4	56.446	High	60.612	High	61.122	High
5	92.196	Very High	80.32	Very High	86.48	Very High
6	69.39	High	69.39	High	66.992	High
7	66.56	High	66.56	High	85	Very High
8	69.438	High	68.456	High	50.41	High
9	65.13	High	57.297	High	64.56	High
10	66.185	High	66.185	High	92.473	Very High
11	73.072	High	51.905	High		
12	80	Very High	80	Very High		
13	78.932	High	71.252	High		
14	66.038	High	78.838	High		

From the WWL data, further analysis can also be carried out to see which indicators have the greatest product value. Figure 5, Figure 6, and Figure 7 show the graph and percentage of product value in the PMM program in general, in PU, and in SU.



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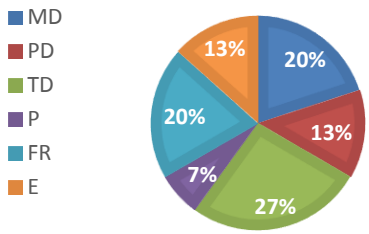
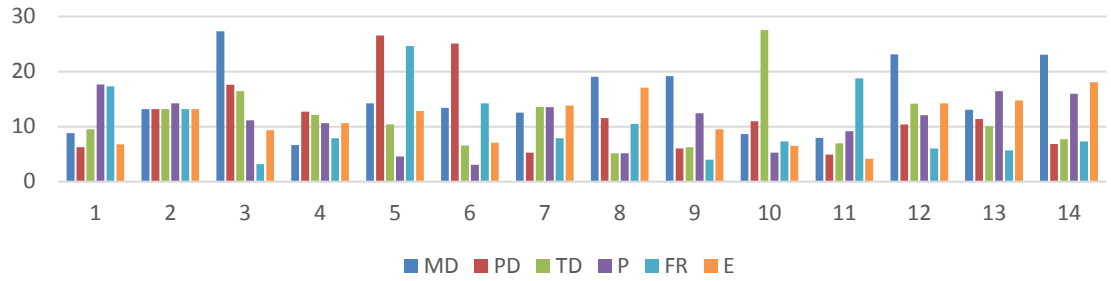


(b)

Figure 5. (a) Graph of Product Value for each General PMM Indicator, (b) Percentage of Product Value for each General PMM Indicator



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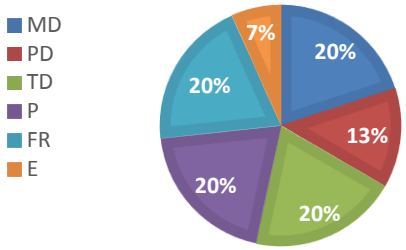
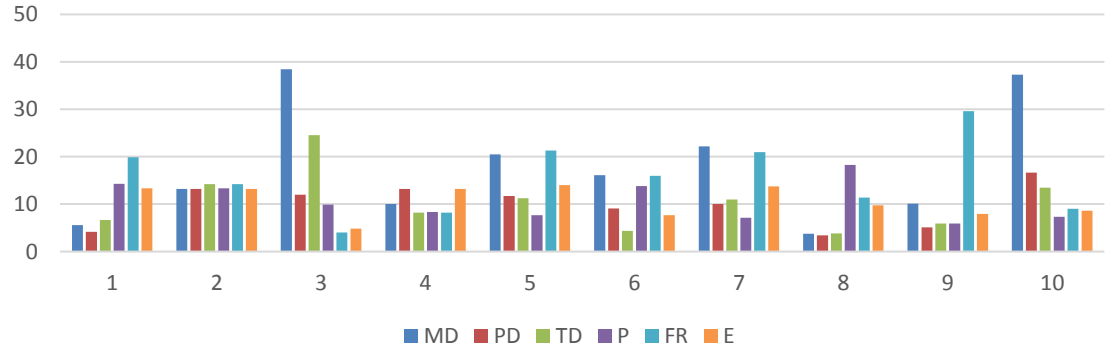


(b)

Figure 6. (a) Graph of Product Value of each PMM Indicator in PU, (b) Percentage of Product Value of each PMM Indicator in PU



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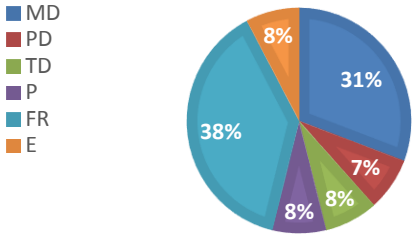

(b)

Figure 7. (a) Graph of Product Value of each PMM Indicator in SU, (b) Percentage of Product Value of each PMM Indicator in SU

From Figure 5, it can be seen that the Temporal Demand (TD) is the most important indicator in participating in the PMM outbound in general with a percentage of 27%. From Figure 6, it can be seen

that Mental Demand (MD), Temporal Demand (TD), Performance (P), and Frustration Levels (FL) have the same importance level indicated by the same large percentage value of 20%. Meanwhile, from Figure 7 it can be seen that the Frustration Level (FL) is the most important indicator in participating in the outbound PMM program at SU with a percentage of 38%.

Based on the results obtained, there are some implications for student and UNIX. For the students, they have to pay more attention to Temporal Demand (TD). It can be concluded form the result shown that Temporal Demand (TD) or Time be the most important indicator. This study gives suggestion for the student to give more attention for the time management. So, the student able to undergo and finish the PMM with low or medium mental workload. In addition, UNIX can take some consideration about giving the brief (tips and tricks) for student before participating the PMM to prepare mentally and choose more private university for destination university. The respondent declared that they took more than 24 credits in one semester from origin and destination university. So, UNIX can also reconsider the credit policy that must be taken by students who take part in the PMM program so that the mental workload of students is balanced because excessive workload can cause stress (Fahamsyah, 2017). Either simultaneously or partially individual stress variables, group stress, and organizational stress has a significant effect to their performance (Amrianah, 2019).

CONCLUSION

The results of the analysis using the NASA-TLX method, in general, 25% of student have very high mental workload and 75% of student have high category mental workload. From this result, UNIX can take some consideration about giving the brief for student before participating the PMM to prepare mentally. 50% of students who take PMM in State University in the high mental workload category and the rest is in the very high category. The percentage of students who take PMM in State University as much as 25% is in the very high category and 75% is in the high category. For further PMM, UNIX can choose more private university for destination university. From this study, it can be concluded the mental workload for PMM in general. For further study, it could be more detail to discuss about student mental workload for PMM in every single activity.

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