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Application of the Modified Cooper-Harper Method (MCH) and Subjective Workload Assessment Technique (SWAT) in Hospital

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Abstract: The Modified Cooper-Harper (MCH) and Subjective-Workload Assessment Technique (SWAT) method is a measurement method to calculate the mental workload experienced by a person. Both of these methods use a subjective approach in determining the outcome of a mental workload. Measurement analysis on the Modified Cooper-Harper (MCH) method is to provide an assessment of the work carried out by respondents based on the decision tree then translated into the questionnaire. The results of the questionnaire were used to infer the mental workload experienced by respondents. While the measurement analysis in the Subjective-workload assessment technique (SWAT) method is to sort 27 SWAT cards where the sorting results are used as a basis for evaluating the mental workload felt by the respondent. The respondents selected in this study were nurses who worked in Malang City hospitals**.**

Keywords: Modified Cooper Harper (MCH), Subjective Workload Assessment Technique (SWAT) and Mental Workload.

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I. INTRODUCTION

Basically a person when working experiences 2 types of workload, namely physical workload and mental workload. According to Arianti and Dewantari (2011), the physical workload is classified as an external workload, namely the workload that comes from the work being done. Meanwhile, according to Jex (1988), the definition of mental workload is the difference between the workload demands of a task with the maximum capacity of a person's mental burden in a motivated condition. Among the two types of workload, the mental workload is a workload that is quite difficult to detect. The reason is because the mental workload has no symptoms or changes experienced by someone when working, but directly affects the results of work.The mental workload itself has 2 approaches to measuring, namely an objective approach and a subjective approach. Among these two mental workload approaches, subjective mental workload measurement is a measurement technique that is most often used because it has a high level of validity. According to Pheasant (1991) the objective of measuring mental workload subjectively is to determine the best measurement scale based on experimental calculations and identify workload factors that are directly related to the mental workload. The measurement of mental workload with a subjective approach has several methods including the NASA TLX method, RSME (Rating Scale Mental Effort), SWAT (Subjective Workload Assessment Technique) and MCH (Modified Cooper Harper). Among these methods, the SWAT and MCH methods have similarities in defining the criteria used to indicate mental workload. If the SWAT method has 3 criteria, namely light, medium, high. While the MCH method has 4 criteria, namely light, moderate, heavy and very heavy. SWAT method in analyzing mental workload using 3 dimensions, namely time dimension, business dimension and psychological dimension. The three dimensions are combined into 27 SWAT cards where respondents must sort the cards from the lowest mental workload to the high workload according to their perception. The results of the card sorting are used as the basis of the respondent in assessing or critiquing the mental workload felt when working. The MCH method in analyzing the mental workload uses a decision tree that contains categories, criteria to scale. This decision tree is then translated into a questionnaire, where the questionnaire is filled out by respondents to determine the mental workload when working. Case studies and respondents selected in analyzing both the SWAT and MCH mental workload methods were 15 nurses working in the hospital.

II. METHODOLOGY

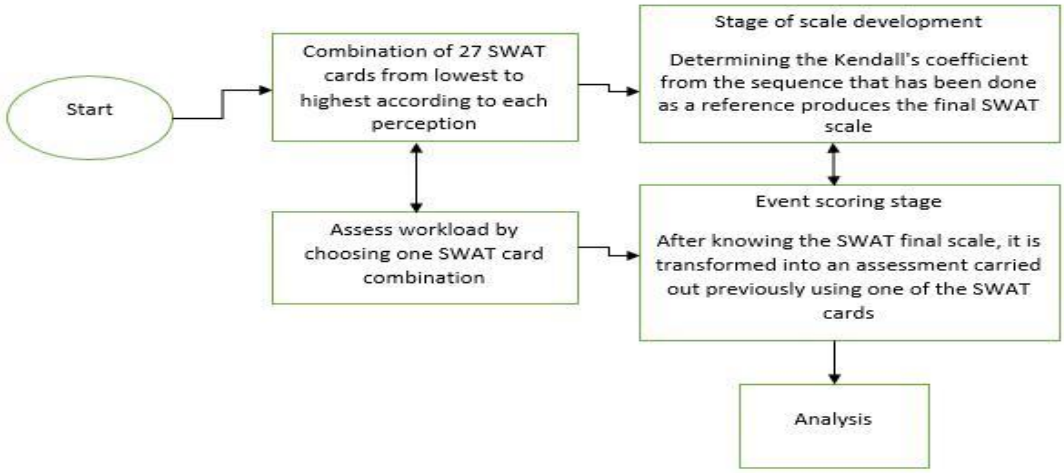

Figure 1: Stages of analysis of the SWAT method

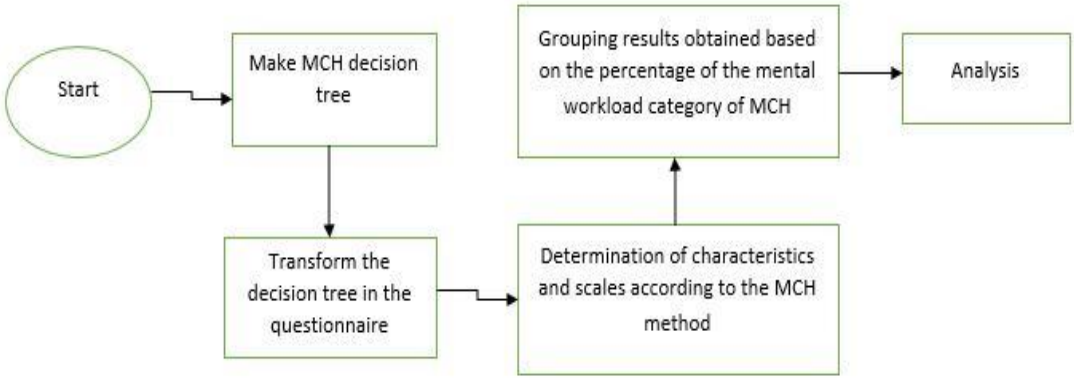

Figure 2: Stages of analysis of the MCH method

From the stages described in **Figure 1** and **Figure 2** show that the two methods use a subjective approach to analyze a person's mental workload. In the MCH method it is known that the first step in analyzing is by making a decision tree that is transformed into a questionnaire. As for **Figure 3** is an explanation of the decision tree that has been transformed.

	Job Characteristics	Meeting the needs (demand) of the operator in the selection of jobs needed	Rating
Light Work category	Very desirable / satisfied with what is provided	Nurses are really satisfied with the facilities provided by the hospital in completing their work and help provide solutions if there are problems that afflict nurses in their work,	1
	Quite desirable / satisfied but there are few notes	Nurses were almost satisfied with the facilities provided by the hospital even though there were some who felt inadequate to complete their work.	2
	Fairness	In general, the facilities provided by hospitals for nurses in completing their daily work are quite in accordance with their uses. But the number is insufficient to complete the work so there is no satisfaction with the nurse.	3
Medium Job category	It's natural but interferes with performance	The facilities provided by the hospital as a supporter of nurses' work every day in accordance with their uses even though the amount is not sufficient at all plus nurses still have to make an effort to make the facility run.	4
	Not fair	The interaction between nurses and the facilities provided by the hospital cannot work together so that the work done by nurses can be completed but not necessarily true	5
	Tends to be less desirable	Nurses can only use the facilities provided by the hospital to complete one by one task that must be completed by the hospital cannot immediately do all the tasks.	6
Heavy Work category	Less desirable	The facilities provided by the hospital can only help nurses in carrying out their duties and the rest of the nurses must need to complete their own work and the problems they face with their thoughts or knowledge that they have	7
	Undesirable	The hospital provided facilities for nurses but the design of these facilities made it difficult for nurses to use them in completing their work.	8
	Not desirable and tends to be avoided	The design of facilities provided by the hospital for nurses even disturbs nurses in completing their duties	9
Very Heavy Job category	Not desirable and highly avoided	The facilities and designs provided by the hospital to nurses do not help at all the work they have to do or the problems they face. So that their work fails or cannot be completed.	10

Figure 3: Decision tree that has been transformed into the MCH method questionnaire

The next step is to recapitulate the results obtained from the respondents. It has been explained in the previous chapter that the respondents chosen were 15 nurses working in the hospital. **Table 1** is the result of grouping the MCH method questionnaire to 15 nurses (respondents).decision tree that has been transformed into the MCH method questionnaire

Table 1. Results of grouping MCH questionnaires on 20 nurses (respondents)

Scale	The number of nurses who choose the scale	Workload characteristics
2	6	Satisfied but there are few notes
3	4	Fairness
4	3	It's natural but interferes with performance
5	1	Not fair
7	1	Less desirable
Sum	15	

In the SWAT method the first step that must be done is to sort the SWAT card combinations which number 27 cards. From the lowest mental workload to the highest workload according to respondents' perceptions. For more details in **Figure 4** is the level of the combination of 27 SWAT cards according to Garry B. Raid (1989). And **Table 2** is the result of the recapitulation of a combination of 27 SWAT cards according to the perception of 20 nurses.

Kartu SWAT	N			B			W			F			J			C			X		
Dimensi	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S
Skala	1	1	1	1	1	2	1	1	3	1	2	1	1	2	2	1	2	3	1	3	1
Kartu SWAT	S			M			U			G			Z			V			Q		
Dimensi	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S
Skala	1	3	2	1	3	3	2	1	1	2	1	2	2	1	3	2	2	1	2	2	2
Kartu SWAT	ZZ			K			E			R			H			P			D		
Dimensi	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S
Skala	2	2	3	2	3	1	2	3	2	2	3	3	3	1	1	3	1	2	3	1	3
Kartu SWAT	Y			A			O			L			T			I					
Dimensi	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S			
Skala	3	2	1	3	2	2	3	2	3	3	3	1	3	3	2	3	3	3			

Figure 4: Level of combination of 27 SWAT cards according to Garry B. Raid (1989)

Table 2. Recapitulation of 27 SWAT Cards in 15 Nurses (Respondents)

Sequence	A Sequence of SWAT Cards according to Nurse's perception (Respondent)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
2	H	B	B	F	B	F	B	B	B	U	S	H	B	B	S
3	F	F	F	H	F	B	F	F	C	W	B	F	F	P	B
4	U	C	W	W	W	U	U	W	F	H	F	U	C	F	F
5	P	U	U	U	X	P	C	X	U	B	G	C	U	U	V
6	C	M	J	J	C	X	J	C	M	J	V	J	M	C	G
7	J	J	M	M	J	H	V	J	J	X	J	V	J	X	M
8	X	V	V	V	S	V	M	S	V	G	M	M	V	H	X
9	W	W	G	G	G	S	X	M	W	F	W	X	X	W	W
10	V	X	X	B	U	M	W	U	X	P	X	W	W	G	Y
11	B	G	C	C	M	Q	Q	G	G	C	Q	B	G	J	P
12	K	K	S	S	Q	Z	P	Q	K	V	P	P	K	Q	C
13	S	P	K	Z	V	W	S	V	P	S	Z	S	Q	S	U
14	M	Q	Q	X	Z	Y	G	Z	Q	Q	Y	G	P	V	Q
15	L	S	P	P	K	K	Z	K	S	R	C	Z	S	D	A
16	Z	Y	Y	Y	E	ZZ	Y	E	Z	E	K	Y	Z	E	J
17	Y	Z	Z	K	ZZ	R	ZZ	ZZ	Y	K	U	D	Y	K	K
18	ZZ	A	H	Q	R	C	L	R	A	D	A	L	A	M	L
19	Q	D	D	D	H	G	H	H	D	M	ZZ	Q	D	Z	D
20	G	E	E	E	Y	E	E	P	E	Z	E	E	E	R	H
21	E	L	L	L	L	D	A	L	H	O	D	A	H	T	Z
22	A	H	A	A	A	A	D	A	L	Y	L	ZZ	L	ZZ	E
23	D	ZZ	ZZ	ZZ	D	J	R	D	ZZ	T	H	R	ZZ	L	ZZ
24	R	O	O	O	P	L	O	Y	O	ZZ	O	O	O	Y	O
25	O	R	R	R	O	T	K	O	R	L	T	K	R	A	T
26	T	T	T	T	T	O	T	T	T	A	R	T	T	O	R
27	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

The next step in the SWAT method is to evaluate the workload felt by the respondent by choosing one SWAT card combination. And in **Table 3** is the result of an assessment conducted by 15 nurses (respondents) on their work.

Table 3. Assessment of 15 Nurses (Respondents) Against Work Using one SWAT card

Nurse (respondent)	Assessment of his work	Nurse (respondent)	Assessment of his work
1	I (3-3-3)	9	H (3-1-1)
2	G (2-1-2)	10	O (3-2-3)
3	C (1-2-3)	11	V (2-2-1)
4	S (1-3-2)	12	Y (3-2-1)
5	M (1-3-3)	13	O (3-2-3)
6	A (3-2-2)	14	Q (2-2-2)
7	L (3-3-1)	15	U (2-1-1)
8	R (2-3-3)		

III. PERFORMANCE EVALUATION

In this section the MCH (Modified Cooper-Harper) method tries to do a percentage of whether the work carried out by 15 nurses in the inpatient section is classified as a job with a heavy or light mental workload or other. And in **Table 4** is the percentage of nurses' mental workload criteria according to the MCH method.

Table 4. The percentage of nurses mental workload criteria according to the MCH method

No.	Scale	Percentage	Criteria
1	2	40%	light mental workload
2	3	26,67%	light mental workload
3	4	20%	moderate mental workload
4	5	6,67%	moderate mental workload
5	7	6,67%	heavy mental workload

In this section the SWAT (Subjective Workload Assessment Technique) method using a software application to make it easier to find out the results of the mental workload of 15 nurses. And the results of the software application obtained the final scale of the SWAT card based on the sorting done by 15 nurses (respondents). **Table 5** is the final scale value of the SWAT card from the perception of 15 nurses. And **Table 6** is an assessment of the mental workload experienced by 15 nurses with the final scale of the SWAT card.

Table 5. The final scale value of the SWAT card from the perception of 15 nurses

Number	SWAT card	Combination of Workloads			SWAT Card Final Scale Value
		Time (T)	Effort (E)	Stress (S)	
1	N	1	1	1	0
2	B	1	1	2	12.5
3	W	1	1	3	21.7
4	F	1	2	1	13.9
5	J	1	2	2	26.4
6	C	1	2	3	35.6
7	X	1	3	1	28.3
8	S	1	3	2	40.8
9	M	1	3	3	50
10	U	2	1	1	31
11	G	2	1	2	43.5
12	Z	2	1	3	52.7
13	V	2	2	1	44.9
14	Q	2	2	2	57.4
15	ZZ	2	2	3	66.6
16	K	2	3	1	59.2
17	E	2	3	2	71.8
18	R	2	3	3	81
19	H	3	1	1	50
20	P	3	1	2	62.5
21	D	3	1	3	71.7
22	Y	3	2	2	63.9
23	A	3	2	2	76.4
24	O	3	2	3	85.6
25	L	3	3	1	78.3
26	T	3	3	2	90.8
27	I	3	3	3	100

After getting the final result for each SWAT card. The next step is to confirm the nurses' assessment of their work according to their assumptions and group them into 3 categories of mental workload. The 3 categories are as follows:

1. Lower load (if the final SWAT card value is between 0-40)
2. Medium load (if the final SWAT card value is between 41-60)
3. Over load (if the final SWAT card value is between 61-100)

Table 6. Assessment Results of 20 Nurses Based on SWAT and Category Scale Conversions

Nurses (responden)	Assessment of his work	Criteria	Nurses (responden)	Assessment of his work	Criteria
1	100	*Over load*	9	50	*Medium load*
2	43.5	*Medium load*	10	85.6	*Over load*
3	35.6	*Lower load*	11	44.9	*Medium load*
4	40.8	*Medium load*	12	63.9	*Over load*
5	50	*Medium load*	13	85.6	*Over load*
6	76.4	*Over load*	14	57.4	*Medium load*
7	78.3	*Over load*	15	31	*Lower load*
8	81	*Over load*			

IV. CONCLUSION

From the analysis of the two workload methods used, the MCH method and the SWAT method found different results. According to the MCH method analysis of 15 nurses working in the inpatient installation section, most (66.67%) nurses assessed the mental workload received as belonging to the mild category. While according to the SWAT method analysis of 15 nurses (respondents), almost 46.67% considered that the mental workload received was classified as high. And from the results obtained, two conclusions can be drawn. The first conclusion is that although the two methods have similarities in terms of the approach to measurement, but not necessarily the results obtained are also the same. The second conclusion is that differences in dimensions also affect the results obtained.

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