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Workload Measurement Optimalization Using Hybrid FTE-MCH to Represent the Comprehensive Workload (A Case Study of Special School and Senior High School)

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Abstract. *This study examined the workload of special school teachers and high school teachers both objectively and subjectively. Workload measurements were conducted using the Full-Time Equivalent (FTE), Meister Questionnaire, and hybrid FTE-MCH methods. The hybrid FTE-MCH method combines objective and subjective workload measurements to provide a comprehensive perspective. The results showed that objective workload measurement based on time using the FTE method showed that high schools teachers have a higher workload compared to special school teachers. In contrast, the subjective workload measurement based on perceptions using the Meister Questionnaire showed that special school teachers have a greater workload. Overall, the results of the hybrid FTE-MCH method retrieved that special school teachers have higher workloads compared to high school teachers. This method integrates objective and subjective measurements, thus providing a more comprehensive overview of teachers' workload.*

Keywords: *full time equivalent; hybrid FTE-MCH; meister questionnaire; workload.*

I. INTRODUCTION

Education can be said to be a process carried out in a deliberate or planned manner that aims to form the next generation that is proficient in supporting the progress of the nation and state (Rahmadhani, 2017). In Indonesia, there are three educational pathways, namely formal, non-formal and informal education as stipulated (Republik Indonesia, 2003). Special schools and senior high schools are includein Law Number 20 Year 2003 Article (Sari, Nuralma, Feocliamsyah, Hafiizh, & Sunardi, 2022). In this research, the research objects to be studied are teachers of Special School X and Senior High School Y.

In education, teachers are the main pillar. Teachers can be said to be the main actors who are directly involved in the teaching and learning process, especially formal learning in state schools (Rahmadhani, 2017). In line with the level of education and abilities a teacher has, his or her duties and work are also different (Zetli, 2019). According to (Wulan & Apriliani, 2017) special education teachers have responsibilities that are certainly greater than ordinary teachers because they are different in providing learning and interacting with students who have special characteristics and in the teaching process special education teachers need greater patience in teaching their students. Meanwhile, according to (Zetli, 2019) high school teachers generally do not act as class teachers, they are usually assigned to deliver one subject to a number of classes according to their knowledge specifications. Workload is a problem for special education teachers (Widiastuti, Sulistiani, & Kurniawan, 2017), this is because according to Kusumadewi (2013) in (Widiastuti et al., 2017) SLB teachers must not only be able to provide lessons on various knowledge and skills in accordance with the potential and character of their students, but they must also be able to function as paramedics, therapists, counsellors and administrators.

Workload is a combination or unit of activities that must be done and completed by the position holder within a certain deadline

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(Zekben & Prastawa, n.d.). Extreme levels of mental workload can lead to operator monotony, low performance and operating errors (Lin & Cai, 2009), therefore workload measurement is very important to do because measuring workload can determine how heavy or light the workload that can be accepted by a person's body (Yuliani, Tirtayasa, Adiatmika, Iridiastadi, & Adiputra, 2021). Workload measurement techniques vary with respect to certain properties that determine the usefulness of a technique for individual applications (Eggemeier, 1988). Workload measurement can use the full time equivalent (FTE), modified cooper harper (MCH), and meister questionnaire methods.

Full time equivalent (FTE) is a method to measure workload by calculating workload by comparing the time needed to do work with the effective working time available (Adawiyah & Sukmawati, 2013). The use of the full time equivalent (FTE) method has been used in several previous studies, including research conducted by (Adi & Rusindiyanto, 2020) measuring teller workload at PT Bank Jatim with the aim of knowing the optimal number of tellers. (Cain, 2007) explains that a very important reason for measuring workload is to know the mental effort that must be expended when performing tasks in order to predict system performance and employee performance. The FTE value can be converted to the number of employee requirements by dividing the employee's working time by the company's working time in the work period (Gilbert & Buchholzer, 2022). By measuring workload using the full time equivalent (FTE) method, it is expected to find out how many teachers are ideal at Special School X and Senior High School Y.

Combining methods is done to get better results, one example of the development of weighting methods is in the NASA-TLX method weighting research which is reviewed by carrying out the weighting process using the Swing and Analytic Hierarchy Process (AHP) method (Virtanen, Mansikka, Kontio, & Harris, 2022). Hybrid FTE-MCH is a combination of the full time equivalent (FTE) and Modified Cooper Harper (MCH) methods. The FTE method is one of the objective workload measurement methods (Wardanis, 2018) while the MCH method is one of the subjective workload measurement methods (Farhah & Purwandari, 2020). Objective workload measurements are collected based on facts and subjective workload measurements are collected from individual opinions, there is a gap between objective and subjective workload measurements, namely objective workload measurements are carried out using information and data in real time and do not depend on the object doing the work. In contrast, subjective workload measurements are highly dependent on the object doing the work (Rusnock, Borghetti, & McQuaid, 2015). The combination of FTE and MCH methods is expected to fill the gap between objective and subjective workload measurements.

Meanwhile, the meister questionnaire method is one of the standardised mental load measurement instruments. This questionnaire was used to collect subjective perspective of job constraints and characteristics (Silva, Costa, & Saraiva, 2012) and this method is used for subjective assessment of the effect of work activities on the psyche of employees in three factors, namely overload, monotony, and non-specific (non-specific reaction to stress) (Hladký and Židková, 1999) in (Dębska, Pasek, & Wilczek-Rużyczka, 2017).

In this paper, the author wants to compare the workload of teachers of Special School X and Senior High School Y and find out the workload felt by teachers of Special School X and Senior High School Y.

II. Research Method

This paper, the author wants to compare the workload of teachers of Special School X and Senior High School Y and find out the workload felt by teachers of Special School X and Senior High School Y with several method of measurement. The methods used in this research are full time equivalent (FTE), meister questionnaire, and Hybrid FTE-MCH. Full Time Equivalent (FTE) is one method that can be used to measure time-based workload. This is because the FTE method is done by comparing work

completion time and available work time subjectively (Wardanis, 2018). while meister questionnaire is a method that can be used to assess work-related mental load based on subjective reactions to the load (Dobroch, Baczewska, Szyłejko, Chomicz, & Knapp, 2021). Mental workload depends on the characteristics and nature of the task, and this can affect performance (Serra, De Falco, Maggi, De Piano, & Nocera, 2022). Additional aspects of mental workload include subjective feelings, effort, individual differences, strategies, and practices (Kantowitz, 1987). The Meister Questionnaire assessment consists of 10 items (time pressure, low job satisfaction, high responsibility, boring work, problems and conflicts, monotonous work, nervous, over-saturation, fatigue, decreased productivity) and is divided into 3 partial scales (overload, monotone, non specific) (Debska, Wilczek-Ruzyczka, Foryś, & Pasek, 2013). On the other side hybrid FTE-MCH is a combination of the two methods where the FTE value will be added to the weight obtained using the MCH method (Asyari, Kustian, & Musmuallim, 2024). Wierelli and Cassali (1983) in a journal written (Donmez, Cummings, Graham, & Brzezinski, 2010) state that the Modified Cooper Harper (MCH) Scale is an approach that takes into account the combination of scales between physical and mental workload. Based on Wierwille and Casali modified the cooper harper method to produce the MCH scale, which is a 10-point scale that uses a logic tree to help users assess workload (Warr, Cole, & Reid, 1986) as shown in Figure 1. The job descriptions of teachers at Special School X and Senior High School Y refer to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 15 of 2018 on Fulfilling the Workload of Teachers, Principals, and School Supervisors and based on the Guidelines for Calculating Teacher Workload and Performance Remuneration Allowance (Planning for Learning, Implementing Learning, Assessing Learning Outcomes, Guiding and Training Learners, Carry out additional tasks as a homeroom teacher, Carrying out other additional tasks). The following is the data of teachers at Special School X and teachers at Senior High School Y are shown in Tables 1 and 2. Teachers at Senior High School Y were only selected who had an age range between 25-52 years old with working hours of 30-34 lessons per week.

Table 1. Teacher of Special School X

No	Name	Gender	Age
1	X1	Female	26
2	X2	Female	25
3	X3	Female	33
4	X4	Female	28
5	X5	Female	52
6	X6	Female	43
7	X7	Female	33
8	X8	Male	28
9	X9	Male	34

Table 2. Teacher of Senior High School Y

No	Name	Gender	Age
1	Y1	Female	36
2	Y2	Female	28
3	Y3	Female	28
4	Y4	Female	26
5	Y5	Female	25
6	Y6	Female	49
7	Y7	Female	41
8	Y8	Female	45
9	Y9	Male	47

III. RESULT AND DISCUSSION

Results

Based on the results of workload calculations, the results obtained in 3 methods are as below:

1. Full Time Equivalent (FTE)

The process of calculating the FTE value is carried out by means of the working time/year that has been adjusted with allowances divided by the effective working time/year (Chan, Pratiwi, Sanjaya, & Rahardjo, 2018) with the allowance factor used in the FTE calculation is 15% thus obtaining the FTE calculation results as follows:

Table 3. FTE Value for Teachers of Special School X

Name	Working Hours/Year (Minutes)	Effective Working Hours/Year (Minutes)	FTE	Category
X1	122610		1,33	Overload
X2	122610		1,33	Overload
X3	119730		1,299	Overload
X4	122610		1,33	Overload
X5	122610	92182,5	1,33	Overload
X6	119730		1,299	Overload
X7	119730		1,299	Overload
X8	122610		1,33	Overload
X9	119730		1,299	Overload
	Average		1,316	Overload

Table 4. FTE Value for Teachers of Senior High School Y

Name	Working Hours/Year (Minutes)	Effective Working Hours/Year (Minutes)	FTE	Category
Y1	132480		1,437	Overload
Y2	126480		1,372	Overload
Y3	128160		1,39	Overload
Y4	122880		1,333	Overload
Y5	118800	92182,5	1,289	Normal
Y6	118410		1,285	Normal
Y7	126840		1,376	Overload
Y8	128910		1,398	Overload
Y9	118320		1,284	Normal
Y10	124380		1,349	Overload
	Average		1,351	Overload

Based on Table 3 and 4, it can be seen that the average FTE value for teachers of Special School X is 1,316 with overload category and the average FTE value for teachers of Senior High School Y is 1,351 with overload category. It can be seen that there is a difference in the average FTE value for Special School X teachers and Senior High School Y teachers, which is 0,035. The difference in the average FTE value can occur due to differences in the amount of work done by teachers of Special School X and Senior High School Y.

2. Meister Questionnaire

The items contained in the meister questionnaire method are measured by agreeing/disagreeing on 5 scales. The following are the results of workload calculations using the meister questionnaire method for teachers of Special School X and Senior High School Y as shown in Table 5.

Table 5. Meister Questionnaire Value for Teachers of Special School and Senior High School

No	Item	Critical Median Value	Average	
			Special School	Senior High School
1	Time Pressure	3	2,44	1,7
2	Low Job Satisfaction	2,5	1,78	1,4
3	High Responsibility	3	1,89	1,9
4	Boring Work	2,5	1,78	1,6
5	Problems and Conflicts	2,5	2,22	1,9
6	Monotonous Work	2,5	1,89	1,9
7	Nervous	3	2	1,9
8	Over-saturation	3	2,67	2,4
9	Fatigue	3	2,67	3
10	Decreased Productivity	2,5	2,33	2
	Total		21,67	19,7

Based on Table 5, it can be seen that the value of each item of perceived workload for teachers of Senior High School Y is positive, indicating that the mean value is lower than the median value and based on Table 5, it can be seen that the results of the meister questionnaire calculation for Special School X teachers obtained a score of 21,67 and for Senior High School Y teachers obtained a score of 19,70. Special School X teachers have a greater meister questionnaire value than Senior High School Y teachers with a difference of 1,97. The results of the meister questionnaire value obtained as in table 5 by

Special School X and Senior High School Y teachers are in category 1, namely with a statement that health and performance are unlikely to be affected.

3. Hybrid FTE-MCH

Hybrid FTE-MCH is a combination of the two methods where the FTE value will be added to the weight obtained using the MCH method. The following formula is used in the calculation of hybrid FTE-MCH (Asyari et al., 2024).

Hybrid FTE-MCH = FTE Index + (FTE Index x MCH Scale) (1)

The implication of the FTE-MCH hybrid index value is the same as the FTE value implication which is divided into 3 namely overload, normal, and underload but has a different range of values. The following Table 6 is a table of FTE-MCH hybrid index value categories based on the value range.

Table 6. Hybrid FTE-MCH Value Implications

Hybrid FTE-MCH Index Value	Category
0 – 1,39	Underload
1,40 - 1,75	Normal
> 1,75	Overload

The weight for each job description is obtained through a questionnaire given to respondents using a rating and weight reference based on the modified cooper harper (MCH) method. The following weights for each job description can be seen in Table 7 and 8.

Table 7. Weight Average Score for Teachers at Special School X

Job	Weight Average
Planning for Learning	57%
Implementing Learning	56%
Assessing Learning Outcomes	50%
Guiding and Training Learners	48%
Carry out additional tasks as a homeroom teacher	40%
Carrying out other additional tasks	41%

Table 8. Weight Average Score for Teachers at Senior High School Y

Job	Weight Average
Planning for Learning	49%
Implementing Learning	31%
Assessing Learning Outcomes	54%
Guiding and Training Learners	49%
Carry out additional tasks as a homeroom teacher	46%
Carrying out other additional tasks	36%

Based on Tables 6 and 7, it can be seen that the largest weight difference is in the work of implementing learning with a difference of 25% with a weight value for special school teachers of 56% and for senior high school teachers of 31%.

The calculation of the workload of teachers of Special School X and Senior High School Y with the Hybrid FTE-MCH method is obtained based on calculations that have been carried out using Formula (1). Table 9 show the results of the recapitulation of hybrid FTE-MCH value.

Table 9. Hybrid FTE-MCH Value for Teachers of Special School X and Senior High School Y

Teacher of Special School	Hybrid FTE-MCH Value	Teacher of Senior High School	Hybrid FTE-MCH Value
X1	2,103	Y1	2,125
X2	1,919	Y2	1,934
X3	1,921	Y3	1,958
X4	1,859	Y4	1,627
X5	1,981	Y5	1,796
X6	2,197	Y6	1,513
X7	2,073	Y7	1,734
X8	2,222	Y8	1,869
X9	1,939	Y9	1,952
		Y10	1,909
Averange	2,024	Average	1,842

Based on Table 9, it can be seen that the average value of hybrid FTE-MCH for teachers of Special School X is 2,024 and the average value of hybrid FTE-MCH for teachers of Senior High School Y is 1,842. It can be seen that there is a

difference in the average value of FTE for Special School X teachers and Senior High School Y teachers, which is 0,182. The difference in the average value of hybrid FTE-MCH can occur due to differences in the amount of work done and the weight given by teachers of Special School X and Senior High School Y.

After obtaining the FTE value for each teacher, the optimal number of teachers was calculated based on the FTE value. The calculation of the optimal number of teachers is only done for Special School X teachers, this is because for Senior High School Y teachers are only taken based on the criteria set so that not all teachers are calculated for the FTE value. The calculation of workload was carried out in the same way as in Table 10, namely by dividing the total FTE value of special school teachers X by the optimal number of teachers (Adi, 2020).

Table 10. Calculation of the Optimal Number of Teachers for Special School X

Total FTE Index	Number of Teachers	Average FTE Index	Category
11,846	9 (Actual)	1,316	Overload
11,846	10 (Optimal)	1,185	Normal

Based on the calculation in Table 10 the number of teachers who can optimise teacher performance at Special School X is 10 teachers so it is recommended to add 1 additional teacher to be placed in Special School X so that the workload can be divided evenly. The calculation of the optimal number of teachers is also done based on the hybrid FTE-MCH value using the same method as before.

The following are the results of the calculation of the optimal number of teachers based on the hybrid FTE-MCH value shown in Table 11.

Table 11. Calculation of Optimal Number of Teachers for Special School X Based on Hybrid FTE-MCH Value

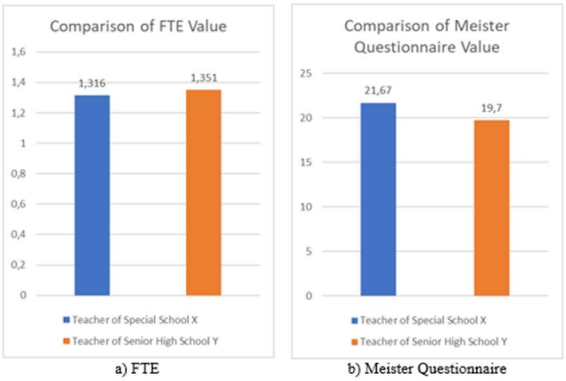
Total Hybrid FTE-MCH Index	Number of Teachers	Average Hybrid FTE-MCH Index	Category
18,213	9 (Actual)	2,024	Overload
18,213	11 (Optimal)	1,656	Normal

Based on the calculations in Table 11, the number of teachers who can optimise teacher performance at Special School X is 11 teachers, so it is recommended to add 2 teachers to be placed in Special School X so that the workload can be divided evenly.

Discussion

This study intends to show the measurement of workload with a new approach, namely by using a combination of objective and subjective workload measurement methods, namely by combining the FTE and MCH methods called hybrid FTE-MCH to be able to see the workload as a whole. This is because the results show that there are differences in objective workload measurements based on time using the FTE method and subjective workload using the meister questionnaire method.

After obtaining the average value of workload using the FTE and meister questionnaire methods for teachers of Special School X and teachers of Senior High School Y, then a comparative analysis of the average value was carried out as can be seen in Figure 2 which shows a comparison graph of the average value of workload using the FTE and meister questionnaire methods for teachers of Special School X and teachers of Senior High School Y.

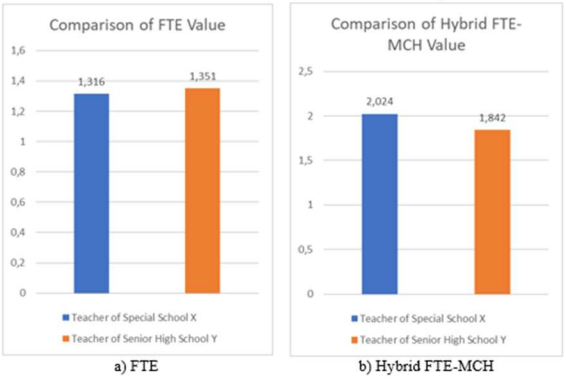


a) FTE b) Meister Questionnaire

Figure 2. Comparison of FTE and Meister Questionnaire Value

Based on Figure 2 (a) it can be seen that the mean value of FTE for teachers of Senior High School Y tends to be greater than teachers of Special School X with a difference of 0,035, it shows that the objective workload based on time for teachers of Senior High School Y requires more time than teachers of Special School X while in Figure 5 (b), it can be seen that the mean value of meister questionnaire for teachers of Special School X tends to be greater than teachers of Senior High School Y with a difference of 19,7, it shows that subjective workload based on perceived workload for teachers of Special School X is greater than teachers of Senior High School Y.

On the other side, after obtaining the average value of workload using the FTE and Hybrid FTE-MCH methods for teachers at Special School X and teachers at Senior High School Y, then analyse the difference in the average value of workload using the FTE method to the Hybrid FTE-MCH method as can be seen in Figure 3.



a) FTE b) Hybrid FTE-MCH

Figure 3. Difference between FTE Value and Hybrid FTE-MCH Value

Based on Figure 3 (a), it can be seen that although in terms of objective workload measurements based on time using the FTE method, teachers of Special School X do not take as much time as teachers of Senior High School Y, but overall the workload of teachers of Special School X is higher than teachers of Senior High School Y with a difference of 0,182. This is indicated by the results of the Hybrid FTE-MCH value in Figure 3 (b) where the value results are a combination of objective workload measurements based on time and subjective workload measurements based on respondents' perspective.

IV. Conclusion

This paper presents a new approach to the FTE method, namely by combining the two methods between the FTE and MCH methods called Hybrid FTE-MCH. The FTE method is one of the objective workload measurement methods (Wardanis, 2018) while the MCH method is one of the subjective workload measurement methods (Farhah & Purwandari, 2020), where later in the calculation of the FTE method will be added to the perception of workload weight using the subjective workload measurement method, namely MCH. The combination of these two methods is expected to see the workload objectively, which is based on the conditions carried out and subjectively, which is obtained by collecting opinions from each individual (Rusnock et al., 2015).

Based on the results obtained, it shows that the results of measuring workload objectively based on time using the FTE method show that the workload of teachers of Senior High School Y has a value that tends to be greater than teachers of Special School X with a difference value of 0.035. Meanwhile, the results of subjective workload measurements based on workload perspective using the meister questionnaire method showed that the workload of teachers of Special School X tended to be greater than that of teachers of Senior High School Y with an average value of 21.67 for teachers of Special School X and 19.70 for teachers of Senior High

School Y. Overall, the workload of teachers at Special School X is greater than teachers at Senior High School Y, this can be seen from the results of measuring workload using the hybrid FTE-MCH method, which combines objective workload measurements based on time and subjective workload measurements based on workload perspective that the workload of Special School X teachers tends to be greater than Senior High School Y teachers with an average value of 2.024 for Special School X teachers and 1.842 for Senior High School Y teachers.

The optimal number of teachers at Special School X based on the results of the workload calculation using the FTE method is 10 teachers, which requires 1 additional teacher at Special School X so that the workload can be evenly distributed. The addition of 1 more teacher can be implemented considering how the process to apply for additional teachers is not easy and requires a long process.

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