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Evaluation of the Influence of Thermal Comfort (PMV) of Classrooms on Teachers' Work Stress Levels in Dry Tropical Areas (Study at SDK Maumere II, Sikka Regency)

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ABSTRACT

This study aims to analyze the effect of thermal comfort (PMV) in classrooms on the level of work stress of teachers in dry tropical areas, especially in SDK Maumere II, Sikka Regency. Quantitative research methods were used by involving all teachers as samples. Data collection was carried out by measuring the physical condition of the classroom and distributing questionnaires. The results showed that the thermal conditions in the classroom did not meet comfort standards, with PMV values outside the comfort range. Correlation and regression analysis showed a significant relationship between thermal comfort and the level of work stress of teachers. The higher the level of thermal comfort, the lower the level of work stress experienced by teachers. The results of this study concluded that thermal comfort is an important factor that affects the level of work stress of teachers and needs to be considered in efforts to improve the quality of the work environment in schools.

ABSTRACT

Penelitian ini bertujuan untuk menganalisis pengaruh kenyamanan termal (PMV) ruang kelas terhadap tingkat stres kerja guru di daerah tropis kering khususnya di SDK Maumere II Kabupaten Sikka. Metode penelitian yang digunakan adalah kuantitatif dengan melibatkan seluruh guru sebagai sampel. Pengumpulan data dilakukan dengan mengukur kondisi fisik ruang kelas dan menyebarkan kuesioner. Hasil penelitian menunjukkan bahwa kondisi termal ruang kelas belum memenuhi standar kenyamanan, dengan nilai PMV berada di luar rentang kenyamanan. Analisis korelasi dan regresi menunjukkan adanya hubungan yang signifikan antara kenyamanan termal dengan tingkat stres kerja guru. Semakin tinggi tingkat kenyamanan termal maka semakin rendah tingkat stres kerja yang dialami guru. Hasil penelitian ini menyimpulkan bahwa kenyamanan termal merupakan faktor penting yang mempengaruhi tingkat stres kerja guru dan perlu diperhatikan dalam upaya peningkatan kualitas lingkungan kerja di sekolah.

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1. INTRODUCTION

The climatological conditions of Sikka Regency, which is a tropical area, are often faced with high air temperatures and varying humidity. Poorly designed school buildings can create an uncomfortable environment for teachers and students.(Pareira, Parera, & Hildegardis, 2023),(Pangestu & Saladin, nd). The quality of the work environment greatly affects the productivity

and well-being of workers, including teachers. One of the significant physical environmental factors is thermal comfort. Thermal comfort is one of the important aspects in creating a good work environment, especially in classrooms where teachers spend most of their time.(Novia, 2019),(Muhaimin, Jumriani, Alviawati, & Angriani, 2023). Thermal comfort of a building is one of the important factors that can affect the productivity and well-being of its occupants. A comfortable learning environment is an important factor in supporting an effective learning process.(Hardianti, Agnesia, Firdaus, Sumianto, & Gunawan, 2025),(Hadibroto, 2024).

As part of the East Nusa Tenggara region, Sikka Regency has a dry tropical climate characterized by high temperatures and very limited rainfall. These extreme climate conditions, as explained in Houghton's research (2009), have a significant impact on water availability, agricultural productivity, and even public health.(Arif, 2020),(Soetedjo & Nguru, 2023). Small temperature fluctuations between day and night and a long dry season are characteristic of the climate in this region.(Lumunon & Betteng, 2013).

In dry tropical areas, thermal comfort in buildings, especially classrooms, is a challenge. Snyder & Anthony (1989) have identified temperature, humidity, and airflow as the main components of thermal comfort. These physical aspects greatly influence a person's comfort, as explained by Muhamad Muhaimin et al.(Hamdy, 2024),(Kautsar, 2017). Excessively high or low air temperatures, extreme humidity, and poor air circulation can cause physical discomfort that impacts concentration and productivity, as emphasized by(Hefnita, Budiyono, & Suhartono, 2023),(Abidin & Budiari Setiawan, nd). Therefore, good building design must take these physical factors into account to create an optimal learning environment.(Ardiyanti, Choirudin, & Ningsih, 2024),(Yuliyanti, Agustin, Utami, Purnomo, & Wijaya, 2024).

High temperature fluctuations and unstable humidity in dry tropical areas can create an uncomfortable working environment for teachers. These conditions, as studied by, can have a direct impact on a person's physical condition.(Idkhan, Baharuddin, & Palerangi, 2021),(Akromi, 2020). Classifying the environment into physical, non-physical, and psychological. A non-optimal physical environment, such as extreme temperature and humidity, can trigger work stress. Prolonged stress due to uncomfortable environmental conditions can disrupt concentration, cause fatigue, and reduce teacher work motivation, thus impacting the quality of learning.(Mugniyah, 2023),(Savitry, Yanova, & Rodhiyah, 2024). The dry tropical climate conditions in Sikka Regency have an impact on teacher activities in schools. The quality of the work environment has long been recognized as an important factor affecting productivity and job satisfaction. In the context of education, classroom comfort is one aspect of the work environment that needs to be considered.(Muhammad, 2024),(Halimah, n.d.).

Job stress is a serious challenge faced by many teachers. This condition not only impacts daily performance, but can also have detrimental long-term consequences. As research has shown, high job stress can lead to decreased motivation, emotional exhaustion, and ongoing physical health problems.(Lestari, Windarwati, Setyawan, & Hidayah, 2022),(Wardhana, 2018). This condition not only hinders teachers' ability to provide effective learning, but can also lead to burnout, which is characterized by emotional exhaustion, depersonalization, and decreased work performance.(Paramita & Afandi, 2024),(Harni, 2022).

According to a survey conducted by the RAND Corporation in 2022, teachers and principals experience higher levels of stress compared to other professions.(Citraningrum & Kurniawati, 2025),(Berutu, 2024). RAND Corporation research identified several factors that contribute to high levels of teacher stress, such as heavy workloads, rapid curriculum changes, and increasing technological demands. The results of this study further reinforce the importance of creating a conducive work environment for teachers, including paying attention to physical comfort aspects such as temperature and humidity in the classroom.(Aprilia, nd),(Nadhila, Widayati, Sugiyanto, & Asnawi, 2024). By adopting a human resource management perspective, this study will examine how the physical condition of the work environment can impact teacher performance and well-being, as well as provide implications for human resource management in educational institutions. Therefore, researchers feel the need to conduct research on the effect of classroom thermal comfort (PMV) on Teachers' Work Stress Levels in dry tropical areas (Study at SDK Maumere II, Sikka Regency)(TAYEB, 2020),(Fadhli, nd).

2. RESEARCH METHODS

This study uses a quantitative method. And the study used a saturated sample of 15 (fifteen) teachers at SDK Maumere II, Sikka Regency. Primary and secondary data sources. The data collection technique used was conducting field studies with interviews, installing measuring instruments to determine thermal comfort in schools, distributing questionnaires to teachers.

2.1 Preparation of Research Instruments and Data Collection

At this stage all instrument tools are prepared and arranged according to the situation and school environment. The software of the measuring instrument is installed to make it easy to input measurement data into the program. The instruments used are: Elitech Rc-4Hc Lcd Digital Temperature Humidity Data Logger, Verliant Heat Stress WGBT and Anemometer with Thermal Technology using a propeller sensor that converts propeller rotation into wind speed. These three tools are installed on the inside of the classroom (in the middle of the room) and on the outside of the classroom (by looking at the direction of the wind), while the questionnaire about teacher work stress was distributed to 15 (fifteen) teachers.

2.2 PMV Measurement

For measuring instruments: researchers use temperature and humidity measuring instruments installed in the classroom. Model: RC-4HC, is a type of temperature and humidity measuring instrument. Serial Number: EF7185F00426, is a unique number to distinguish each device. Total Space: 16000, possibly referring to the data storage capacity of the instrument. Probe Type: Temperature & Humidity, indicates that this instrument measures temperature and humidity. Firmware Version: V1.3, is the software version used on the instrument.

2.3 Data analysis

Correlation Analysis: Correlation analysis is used to determine the relationship between PMV values and work stress levels and how they affect teacher performance. Regression Analysis: Regression analysis is used to predict work stress levels and teacher performance based on PMV values. PMV Measurement Results in one of the classes at SDK Maumere II, Sikka Regency.

Based on the graph shown, we can observe the pattern of temperature and humidity changes over a certain period of time. From the available data, we can see that the temperature and humidity experienced quite significant fluctuations during the measurement period. The temperature varied between 27°C to 33.3°C, while the humidity varied between 61.7% to 71.1%. The average temperature and average humidity provide an overview of the environmental conditions during the measurement period. The MKT value of 28.9°C is likely a reference point or target temperature for the measured environment.

Based on the available data, the wind speed at the time of measurement ranged from 0.985 m/s to 1.055 m/s. This indicates that the wind speed was relatively low and tended to be stable at the time the measurement was taken.

The results of PMV measurements show that the PMV value in the SDI Beru classroom is outside the comfort range (-0.5 to +0.5). Most PMV values are above +0.5, indicating that the classroom is uncomfortable to use.

3. RESULTS AND DISCUSSION

3.1 Research Results Using SPSS

a. Validity Test Results

In the validity test using SPSS software, there are 50 valid statements because the calculated r is greater than the table r of 0.361 or more, so it can be used for analysis of teacher work stress and thermal comfort experienced by teachers.

b. Reliability Test Results

Testing is done by one shot or one-time measurement. SPSS software provides results that a construct or variable is said to be reliable and acceptable if the alpha value is >0.6 (Ghoazali 2009:42) based on the results of the reliability test with the help of SPSS software shown in table 1

Table 1. Reliability Test Results

Cronbach's Alpha	N of Items
.871	50

c. Normality Test Results

In the thermal comfort variable (X), to determine whether the data is normal or not, the Kolmogorov Smirnov formula is also used with the help of the IBM SPSS Release 25.0 program. The results of the normality test calculation on the thermal comfort variable can be seen in the following table 2:

Figure 2. Results of normality test calculations

		Unstandardized Residual
N		88
Normal Parameters	Mean	.0000000
	Std. Deviation	13.71126442
Most Extreme Differences	Absolute	.056
	Positive	
	Negative	-.056
Kolmogorov-Smirnov Z		.529
Asymp. Sig. (2-tailed)		.943

a. Predictors: (Constant), THERMAL COMFORT

b. Dependent Variable: WORK STRESS

Based on the results above, the variable Based on table 2 above, the significance value of the resulting thermal comfort variable (X) (Asymp.sig = 0.943) is greater than the alpha value (a = 0.05). Thus, it can be concluded that the data from the thermal comfort variable (X) is normally distributed.

d. Linearity Test

Linearity Test is used to determine whether or not the relationship between independent variables and dependent variables in a study is linear. The relationship between variables is said to be linear if sig. is greater than or equal to 0.05. The calculation of the linearity test in this study uses the SPSS Release 25.0 program. The results of the linearity test calculation can be seen in table 3.

Table 3 ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
WORK STRESS * THERMAL	Between Groups	(Combined)	9175.579	16	573,474	3.238	.000
		Linearity	5393.005	1	5393.005	30,454	.000

COMFORT	Deviation from Linearity	3782.574	15	252,172	1,424	.160
	Within Groups	12573.319	71	177,089		
	Total	21748.898	87			

Based on table 3 above, the analysis results show that there is a significant linear relationship between work stress and thermal comfort (F Linearity = 30.454; Sig Linearity = .000).

3.2 Partial Hypothesis Test (t-test) t-test

It is a hypothesis test that will be used to determine the effect of independent variables partially on the dependent variable (thermal comfort) on the dependent variable (teacher work stress) by assuming that other independent variables are considered constant. The hypothesis proposed in the partial test (t-test) in this study is the effect of thermal comfort variables on teacher work stress. The t-test (t-test) of the results of this calculation is then compared with the t table using an error rate of 0.05 (5%). The criteria used are as follows: 1) H0 is accepted if the value$thitung \leq ttabel$or sig value > α 2) H0 is rejected if the value$thitung \geq ttabel$or sig value < α

Table 4. Coefficientsa

Unstandardized Coefficients		Standardized Coefficients		
B	Std. Error	Beta	t	Sig.
85,403	12.925		6,608	.000
2.002	.376	.498	5.325	.000

3.3 The effect of thermal comfort on teacher work stress

Based on table 4 above, the results of the simple linear regression equation are as follows: Y = 85.403 + 0.498X Based on these calculations, it can be seen that the value of the thermal comfort variable regression coefficient (X1) of 0.498 is positive at sig 0.000 which is smaller than 0.05, namely 0.000 <0.05. The value of the thermal comfort variable regression coefficient (X1) of 0.498 indicates that there is a positive relationship between thermal comfort and teacher work stress. This means that every one unit increase in thermal comfort will be associated with a 0.498 unit increase in the measured variable (teacher work stress). The significance value (p-value) of 0.000 is smaller than 0.05 (0.000 <0.05). This shows that the results are statistically significant. In other words, there is strong evidence to state that thermal comfort affects teacher work stress. So it can be interpreted that thermal comfort has a positive effect on teacher work stress. This shows that thermal comfort in the classroom will affect the level of teacher work stress.

3.4 The relationship between thermal comfort and teacher work stress

The positive correlation between work stress and thermal comfort indicates that the higher the thermal comfort, the lower the work stress. The correlation value of 0.493 indicates that the relationship is quite strong. The significance value of 0.000 indicates that the results are very significant and cannot be ignored. Thus, the correlation table above shows that there is a significant and positive relationship between thermal comfort and teacher work stress, which is important to consider in efforts to improve a comfortable working environment for teachers. The survey results show that most teachers feel uncomfortable in the classroom. This perception is consistent with the results of the PMV measurement which shows uncomfortable thermal conditions.

4. CONCLUSION

Temperature and Humidity Fluctuations: Thermal conditions in the classroom experienced significant fluctuations, with temperatures ranging from 27°C to 33.3°C and humidity between 61.7% and 71.1%. This condition indicates instability in temperature and humidity that can affect thermal comfort. PMV Values Outside the Comfortable Range: The results of PMV measurements show that most values are above +0.5, indicating that the thermal conditions in the classroom are generally uncomfortable. The results of the validity and reliability tests indicate that the instruments used in this study can be relied on to measure the variables of work stress and thermal comfort.

Regression analysis shows a significant positive relationship between thermal comfort and teacher work stress. This means that the higher the level of thermal comfort, the lower the level of work stress experienced by teachers. The results of this study have important implications for efforts to improve the quality of the work environment in this case the thermal comfort of teachers' classrooms and ultimately, improve the quality of learning in schools. Some implications that can be taken are: (a) The Importance of Thermal Comfort: Thermal comfort is a very important factor in creating a conducive work environment for teachers. Uncomfortable thermal conditions can cause work stress that has a negative impact on teacher performance and well-being. (b) The Need to Improve the Physical Condition of the Classroom: Efforts need to be made to improve the physical condition of the classroom, such as improving ventilation, regulating temperature, and maintaining air humidity to meet thermal comfort standards. (c) Impact on Learning Quality: Comfortable thermal conditions in the classroom not only have an impact on teachers, but can also improve the quality of student learning. Teachers who feel comfortable will be more focused on teaching and can create a more effective learning atmosphere.

REFERENCE

Abidin, Z., & Budiari Setiawan, S. P. (n.d.). ANALISIS HAZARD FISIK RUANG KULIAH STTN YOGYAKARTA DENGAN METODE HIRADC.

Akromi, A. Z. (2020). Perancangan resort di Pantai Payangan Kabupaten Jember dengan pendekatan arsitektur tropis. Universitas Islam Negeri Maulana Malik Ibrahim.

Aprilia, N. I. (n.d.). hubungan lingkungan kerja dengan kinerja guru smk letris indonesia 2 pamulang. Jakarta: FITK UIN Syarif Hidayatullah Jakarta.

Ardiyanti, B., Choirudin, C., & Ningsih, E. F. (2024). Etnomatematika Bangunan Pionering Pramuka terhadap Minat dan Kreativitas Siswa. *Jurnal Penelitian Tindakan Kelas*, *1*(3), 168–173.

Arif, A. (2020). *Sorgum: Benih Leluhur untuk Masa Depan*. Kepustakaan Populer Gramedia.

Berutu, N. (2024). Deteksi Tingkat Depresi Kerja Pada Guru Sekolah Dasar Menggunakan Metode Fuzzy Mamdani. *JURNAL FASILKOM*, *14*(2), 541–548.

Citraningrum, D. A., & Kurniawati, F. (2025). Systematic Literature Review: Memanfaatkan dan Mewaspadai Calling Terhadap Well-Being Pada Guru. *G-Couns: Jurnal Bimbingan Dan Konseling*, *9*(3), 1513–1527.

Fadhli, M. (n.d.). Pengaruh Stres Kerja Dan Lingkungan Kerja Terhadap Kinerja Guru Pada Smpn 21 Kota Bekasi. FEB UIN JAKARTA.

Hadibroto, Y. (2024). Peran Arsitektur dalam Meningkatkan Kesehatan dan Kesejahteraan Penghuni. *Tugas Mahasiswa Program Studi Arsitek*, *1*(1).

Halimah, S. (n.d.). Pengaruh Iklim Sekolah dan Reward Terhadap Kinerja Guru di SMP Negeri Kecamatan Serpong Kota Tangerang Selatan. Jakarta: FITK UIN Syarif Hidayatullah Jakarta.

Hamdy, M. A. (2024). MODEL LINGKUNGAN TERMAL PADA BANGUNAN DENGAN ELEMEN AIR DAN LANSEKAP SEBAGAI PENGUBAH IKLIM MIKRO DI IKLIM TROPIS PANAS DAN LEMBAB= THERMAL ENVIRONMENT MODEL FOR BUILDINGS WITH WATER AND VEGETATION ELEMENTS AS MICROCLIMATE MODIFIERS IN HOT AND HUMID TROPICAL CLIMATE. Universitas Hasanuddin.

Hardianti, S., Agnesia, Y., Firdaus, M., Sumianto, S., & Gunawan, A. (2025). Inspeksi Kesehatan Lingkungan di Sekolah Menengah Kejuruan Perpajakan Riau tahun 2024. *Indonesian Research Journal on Education*, *5*(1), 511–520.

Harni, C. F. (2022). FAKTOR YANG BERHUBUNGAN DENGAN KELELAHAN KERJA GURU SD NEGERI DI KECAMATAN MALILI. Universitas Hasanuddin.

Hefnita, H., Budiyono, B., & Suhartono, S. (2023). Hubungan Antara Kualitas Udara Dengan Gejala Sick Building Syndrome, Bagaimana Penanggulangannya?: Literature Review. *Jurnal Riset Kesehatan Poltekkes Depkes Bandung*, *15*(2), 528–540.

Idkhan, A. M., Baharuddin, F. R., & Palerangi, A. M. (2021). Analisis Ergonomi.

Kautsar, M. R. (2017). Perancangan pusat olahraga pantai di Kabupaten Karangasem, Bali: Tema metafora. Universitas Islam Negeri Maulana Malik Ibrahim.

Lestari, R., Windarwati, H. D., Setyawan, F. E. B., & Hidayah, R. (2022). *Stres, resiliensi, dan tata laksana masalah kesehatan jiwa tenaga kerja setelah pandemi covid-19*. Universitas Brawijaya Press.

Lumunon, A. S., & Betteng, L. (2013). Implementasi Arsitektur Gothik pada Bangunan di Daerah Tropis Lembab. *Media Matrasain*, *10*(2), 38–51.

Mugniyah, A. A. (2023). Hubungan Lingkungan Kerja Fisik dan Non Fisik dengan Stres Kerja pada Pekerja Unit Produksi Bata Ringan PT. Bumi Sarana Beton Makassar= RELATIONSHIP BETWEEN PHYSICAL AND NON PHYSICAL WORK ENVIRONMENT WITH WORK STRES IN LIGHT BRICK PRODUCTION AT PT. BUMI SARAN BETON MAKASSAR. Universitas Hasanuddin.

Muhaimin, M., Jumriani, J., Alviawati, E., & Angriani, P. (2023). Urgensi Kenyamanan Termal dalam Perspektif Pembelajaran. *Geodika: Jurnal Kajian Ilmu Dan Pendidikan Geografi*, *7*(1), 23–32.

Muhammad, A. D. (2024). Pengaruh Iklim Sekolah dan Komitmen terhadap Kinerja Guru di SMA se-Kecamatan Sungai Gelam. Universitas Jambi.

Nadhila, A., Widayati, I., Sugiyanto, H., & Asnawi, A. (2024). Pengaruh Budaya Organisasi dan Lingkungan Kerja Fisik terhadap Kinerja Guru di SMP Al-Huda Surabaya. *Soetomo Administrasi Bisnis*, *2*(2), 517–530.

Novia, J. (2019). Perancangan Lingkungan Pembelajaran yang Sesuai dengan Metode Pembelajaran di Sekolah Lentera Harapan Rote. *Lintas Ruang: Jurnal Pengetahuan Dan Perancangan Desain Interior*, *7*(2), 1–13.

Pangestu, D. M. D., & Saladin, A. (n.d.). STUDI PENERAPAN ARSITEKTUR TROPIS PADA KANTOR BUPATI DI KABUPATEN SIKKA STUDY APPLICATION OF TROPICAL ARCHITECTURE IN THE REGENT'S OFFICE IN SIKKA DISTRICT.

Paramita, L., & Afandi, N. K. (2024). Strategi Guru PAI dalam Mengatasi Burnout di SDN 011 Sangatta Utara. *Jurnal Al Muta'aliyah: Pendidikan Guru Madrasah Ibtidaiyah*, *4*(2), 1–13.

Pareira, Y. T., Parera, Y. P. P., & Hildegardis, C. (2023). Pengaruh Setting Fisik Lingkungan Terhadap Kejadian Dbd (Demam Berdarah Dengue) Berdasarkan Karakteristik Termal Di Kabupaten Sikka, Nusa Tenggara Timur. *JAMBURA Journal of Architecture*, *5*(1), 1–8.

Savitry, N., Yanova, S., & Rodhiyah, Z. (2024). Hubungan Kelelahan Akibat Beban Kerja dan Lingkungan Kerja Terhadap Kinerja Kerja Pegawai Pabrik Di Perusahaan X. teknik lingkungan.

Soetedjo, I. N. P., & Nguru, E. S. O. (2023). *Kualitas Tanah dan Pengelolaannya yang Berkelanjutan*. uwais inspirasi indonesia.

TAYEB, M. (2020). PENGARUH PERMUKAAN TUBUH MANUSIA TERHADAP SENSASI TERMAL DALAM RUANG KELAS. Universitas Hasanuddin.

Wardhana, A. K. (2018). Stres Kerja: Penyebab, Dampak, Dan Solusinya (Studi Kasus Pada Karyawan NET. Yogyakarta).

Yuliyanti, M., Agustin, A., Utami, S. D., Purnomo, S., & Wijaya, S. (2024). Mengembangkan Pendekatan Pendidikan Inklusif Untuk Anak Berkebutuhan Khusus Di Sekolah Dasar: Strategi Desain Dan Implementasi Pembelajaran. *Jurnal Inovasi Pendidikan*, *6*(1).