Thermal Comfort Analysis in the Classrooms of the Faculty of Islamic Education and Teacher Training at UIN Raden Intan Lampung

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Abstract. Thermal comfort in the classroom environment serves as a crucial factor influencing the quality of the teaching and learning process. Preliminary research reveals that a significant number of students at UIN Raden Intan Lampung have expressed complaints regarding excessively hot classroom conditions, lacking adequacy in creating comfort. The primary objective of this study is to assess the extent to which the level of thermal comfort can be achieved in the classrooms within the Faculty of Islamic Education at UIN Raden Intan Lampung. The research methodology applied in this study is qualitative and descriptive, with a focus on variables such as temperature, humidity, wind speed, and lighting levels. The purposively selected sample indicates that the classroom conditions in the Faculty of Islamic Education at UIN Raden Intan Lampung have not yet met the desired standards of thermal comfort.

1 Introduction

The significance of thermal comfort within the classroom cannot be understated, as it exerts a profoundly impactful influence on the enhancement of learning quality and student well-being. Optimal temperature and comfortable thermal conditions not only foster a conducive learning environment but also wield a substantial effect on students' concentration levels and productivity. By establishing an optimal classroom temperature, students are more inclined to concentrate on the subject matter and can circumvent disturbances that may arise due to thermal discomfort. Furthermore, good thermal comfort also yields positive effects on the physical and mental health of students, elevating mood and diminishing fatigue levels. Therefore, paying serious attention to temperature regulation and thermal comfort in the classroom is not merely a step in supporting an effective learning process but also contributes positively to the overall learning experience of students.

Although UIN Raden Intan Lampung holds the 8th position as the most environmentally friendly and sustainable campus according to UIGM's assessment [1], challenges related to thermal comfort persist as a concern during the academic processes within this university. The campus comprises six faculties spread across the main campus,

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with the Faculty of Tarbiyah ranking first in terms of the highest number of students compared to other faculties. The results of preliminary research indicate that many students from the Faculty of Tarbiyah have expressed complaints regarding the excessively high thermal conditions in classrooms, which can disrupt the smooth flow of the optimal learning process.

ASHRAE, acronym for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, provides a definition of thermal comfort as a mental state that reflects an individual's satisfaction with their thermal environment[2]. This concept of thermal comfort involves three dimensions—physical, physiological, and psychological—with the psychological approach to interpreting thermal comfort considered the most comprehensive [3]. The fundamental principle of thermal comfort is to achieve a balance between the human body's temperature and the surrounding environmental temperature. Significant imbalances between human body temperature and the environment can result in discomfort, manifested as either heat or cold sensations[4]. The combination of temperature, humidity, and air movement velocity can create similar thermal conditions, referred to as effective temperature. In tropical regions, thermal comfort is deemed achieved within a temperature range of 22°C to 27°C, with an ideal wind speed between 0.1 to 1.5 m/s [5].

The occupational environmental health standards, as stipulated in the Minister of Health Regulation No. 1405/Menkes/SK/XI/2002, specify that the appropriate temperature and humidity for industrial workplaces fall within the temperature range of 18°C to 30°C, with humidity between 65% and 95%[6]. In alignment with this, SNI 6390:2011, addressing Energy Conservation in Building Air Conditioning Systems, determines that to ensure thermal comfort for building users in lowland regions, the air temperature in workspaces should range from 24°C to 27°C or 25.5°C ± 1.5°C, with a relative humidity of approximately 60% ± 5% [7]. Additional information from SNI-03-6197-2000 sets the recommended minimum illumination levels for various spaces in educational institutions, including classrooms at 250 lux, libraries at 300 lux, laboratories at 500 lux, drawing rooms at 750 lux, and cafeterias at 200 lux [8].

2 Methodology

This research was conducted in early June 2023 at the Faculty of Tarbiyah and Teacher Training of UIN Raden Intan Lampung in the Sukarame District of Bandar Lampung City. Data collection was carried out through a series of measurements encompassing air temperature, air humidity, air velocity, sunlight intensity, room height, room area, and building facade characteristics. The study took place during the dry season, specifically during daytime hours, from 13:00 to 14:00 WIB. Each day, measurements were conducted on one building, with a total of ten program study buildings serving as research locations. The data collection period spanned ten consecutive days, with each day focusing on a different building.

Fig. 1. Research Location - Faculty of Tarbiyah and Teacher Training Lecture Building.

The edifices serving as the research locales comprise lecture spaces within the departments of English Education (PBI), Biology Education (PSPB), Mathematics Education (PSPM), Arabic Language Education (PBA), Early Childhood Islamic Education (PIAUD), Islamic Education Counseling and Guidance (BKPI), Islamic Religious Education (PAI), Physics Education (PSPF), Islamic Education Management (MPI), and Elementary School Teacher Education (PGMI).

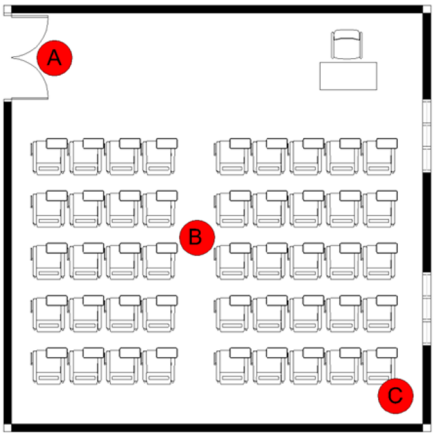

Fig. 2. Sampling points within the classroom

The sampling of classroom spaces was conducted by selecting one room from each building within the Faculty of Tarbiyah premises. Each chosen room was positioned at the central point of the building and relied solely on natural lighting and ventilation. Measurements were taken for a duration of 15 minutes in each room, employing three strategically placed measurement points to ensure variability even within a single room. Point A was positioned closest to the door, point B in the middle of the classroom, and point C farthest from the door. During measurements, the classroom was arranged to resemble the actual lecture environment.

Table 1. Research Instruments

Variable	Standart (SNI)	Instrument
Temperature	20°C-27°C	Termometer
Humidity	55%-60%	Higrometer
Airflow	0,15 m/s-0,25m/s	Anemometer
Light Intensity	250 Lux	Lux Meter

In order to gauge and analyze thermal conditions within the classroom, this research employs a set of standardized precision instruments. Each instrument is selected in accordance with the environmental variables to be measured, aligning with the relevant Indonesian National Standards (Standar Nasional Indonesia or SNI).

3 Result and Discussion

The research findings unveil a comprehensive analysis of the thermal conditions within the classrooms of the Faculty of Tarbiyah and Teacher Training at UIN Raden Intan Lampung. Conducted in early June 2023, this study is centered on a profound understanding of the thermal dynamics shaping the learning environment within this academic institution. The Faculty of Tarbiyah and Teacher Training, being the largest faculty at UIN Raden Intan Lampung, takes center stage in this research.

Table 2. Temperature, humidity, wind speed, and illumination levels in the Faculty of Tarbiyah

No	Location	Temperature (°C)	Humidity (%)	Airflow (m/s)	Light (Lux)
1	PSPB	28.8	68	0	280
2	PSPM	29.9	72	0	330
3	PBI	29.3	70	0	481
4	PSPF	29.8	72	0	251
5	MPI	29.6	78	0	103
6	PIAUD	28.4	71	0	177
7	BKPI	29.8	75	0	324
8	PMII	28.6	67	0	199
9	PAI	30.5	79	0	401
10	PBA	29.7	75	0	333
	Average	29.44	72.7	0	287.9

The air temperature within the classrooms exhibits significant variation, with the highest recorded temperature occurring in the Islamic Religious Education Program (PAI) at 30.5°C, while the lowest temperature is observed in the Early Childhood Islamic Education Program (PIAUD) at 28.4°C. However, the measurement data indicates that the air temperature in the classrooms has not yet met the expected standards.

Air humidity also constitutes a crucial aspect, with the highest humidity recorded in the Islamic Education Management (MPI) classroom reaching 78%, while the lowest humidity is observed in the Islamic Elementary School Teacher Education (PGMI) classroom at

67%. Despite the variations in humidity, the data indicates that the air humidity conditions in the classrooms still fall short of the desired standards.

During the measurement of air velocity using an anemometer, the researchers did not detect any air movement in each of the sampled classrooms. The measurement results indicate that the air velocity in the classrooms has not yet met the standards, indicating the potential lack of air circulation within the enclosed spaces.

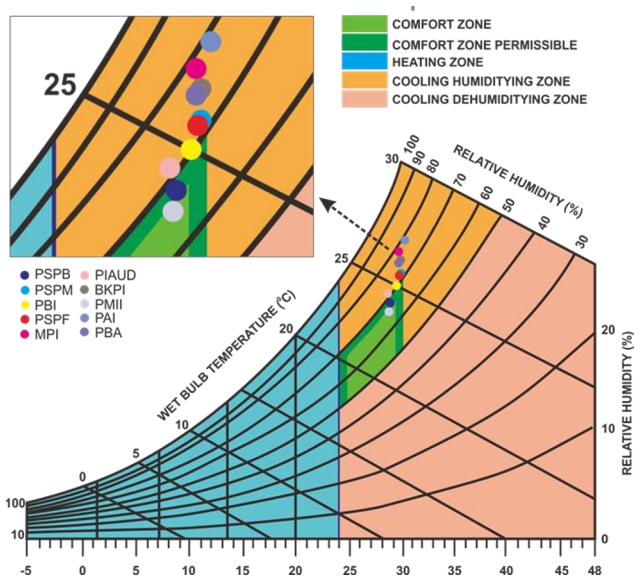

Fig. 3. The thermal comfort achievement zones for each classroom based on SNI

Based on the above SNI graph, the comfort attainment points in each classroom chosen as research samples are evident. The PMII classroom is the only one that falls within the comfortable zone based on the measurement results. Following PMII, PSPB is positioned in the permissible and comfortable zone. The classroom furthest from the comfortable zone is the PAI classroom, with high temperature and humidity levels deviating significantly from the SNI standards.

The analysis of sunlight intensity on the first floor reveals notable variations. Two classrooms, specifically Physics Education with 251 lux and Biology Education with 280 lux, have met the anticipated standards. However, the remaining eight classrooms have yet to meet the standards, attributed to either insufficient or excessive light intensity. The highest sunlight intensity is recorded in the English Education Program, reaching 481 lux, while the lowest occurs in the Islamic Education Management Program, at 103 lux. Measurement data indicates that the illumination conditions in the majority of classrooms still fall short of the expected standards.

The average room temperature measurement in the Faculty of Tarbiyah registers at 29.44°C, indicating a thermal condition slightly exceeding comfort standards. Although this temperature could be considered somewhat elevated, it suggests the potential presence of thermal comfort challenges requiring further attention. Meanwhile, the room humidity level is recorded at 72.7%, falling within a relatively high range for occupant comfort, as balanced humidity is crucial in creating a conducive environment for learning and teaching.

Additionally, special consideration needs to be given to the airflow value, which stands at 0.0 m/s. This figure indicates a lack of air movement within the room, potentially influencing temperature distribution and overall thermal comfort. Low airflow values may

lead to heat concentration in specific areas, impacting the well-being and comfort of space users. Therefore, these average results serve as a crucial foundation for designing improvement strategies to enhance the thermal conditions of classrooms, fostering a more optimal learning environment for both students and instructors.

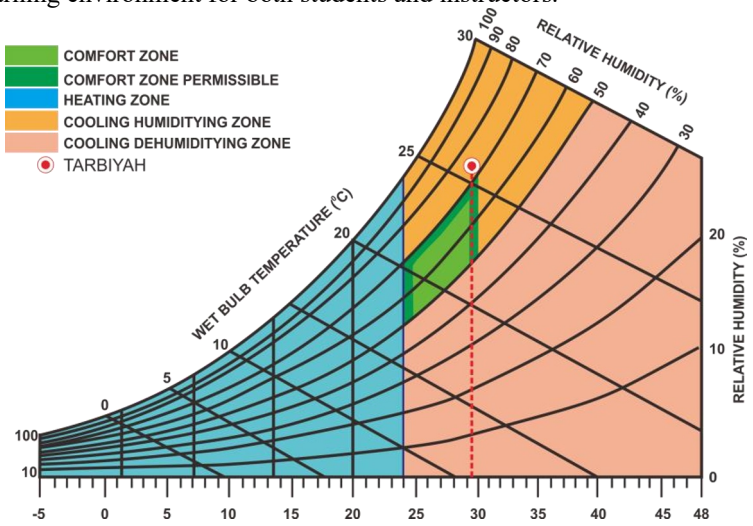

Fig. 3. Dry-bulb Temperature SNI 6390(2011)

In the context where the average room temperature reaches 29.4°C and the humidity level is at 72.7%, this situation can be analyzed by correlating it with the Indonesian National Standards (SNI) and placing it within the perspective of the psychrometric chart in the cooling humidity zone. This zone reflects that, although the temperature may be slightly high, the balance of humidity levels can provide a natural cooling effect. However, with humidity levels above average, there is potential to enhance the perception of discomfort and create less comfortable conditions. A profound understanding of the relationship between temperature and humidity becomes crucial for optimizing thermal conditions and providing a more comfortable experience for room occupants.

4 Conclusion

The thermal comfort evaluation in the classrooms of the Faculty of Tarbiyah, with an average temperature of 29.4°C, humidity at 72.7%, wind speed at 0.0 m/s, and light intensity at 287.9 lux, indicates several aspects that require attention to enhance more optimal thermal conditions. In the context of Indonesian National Standards (SNI), the room temperature, humidity, and wind speed fall outside the desired standard limits, while light intensity signifies adequate illumination levels to support learning activities. Evaluation and adjustments to these parameters become essential in creating a more conducive and comfortable learning environment for room occupants.

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