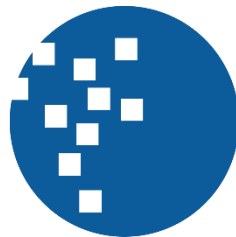


**EVALUATION OF THE INDOOR THERMAL COMFORT IN
CLASSROOMS D1509 AND D1510 AT UNIVERSITAS
MULTIMEDIA NUSANTARA**



UMN

UNIVERSITAS
MULTIMEDIA
NUSANTARA

MBKM REPORT

**MUHAMMAD DZAKY AL-HAIDAR
00000056432**

**ENGINEERING PHYSICS STUDY PROGRAM
FACULTY OF ENGINEERING AND INFORMATICA
UNIVERSITAS MULTIMEDIA NUSANTARA
TANGERANG**

2024

**EVALUATION OF THE INDOOR THERMAL COMFORT IN
CLASSROOMS D1509 AND D1510 AT UNIVERSITAS
MULTIMEDIA NUSANTARA**



MBKM REPORT

Proposed to Fulfill the MBKM Course

**MUHAMMAD DZAKY AL-HAIDAR
00000056432**

**ENGINEERING PHYSICS STUDY PROGRAM
FACULTY OF ENGINEERING AND INFORMATIC
UNIVERSITAS MULTIMEDIA NUSANTARA
TANGERANG
2024**

NO PLAGIARISM STATEMENT

NO PLAGIARISM STATEMENT

I hereby,

Full Name : MUHAMMAD DZAKY AL-HAIDAR
Student ID : 00000056432
Study Program : Engineering Physics

state that the MBKM Report titled:

EVALUATION OF THE INDOOR THERMAL COMFORT IN CLASSROOMS
D1509 AND D1510 AT UNIVERSITAS MULTIMEDIA NUSANTARA

is the result of my own work. It is not plagiarism nor written by anyone else, and all quoted and referenced sources have been correctly stated and included in the Bibliography.

Should it be proven that there is fraud / irregularities in my paper, both related to the MBKM process or report writing, I am willing to accept the consequence of being declared NOT PASS for the MBKM Course that I have taken. I will also bear all legal consequences against me and will not involve University Multimedia Nusantara, regarding the act of plagiarism.

Tangerang, 16 May 2024

(MUHAMMAD DZAKY AL-HAIDAR)

2

Evaluation Of The Indoor Thermal Comfort In Classrooms D1509 and D1510 at Universitas
Multimedia Nusantara, Muhammad Dzaky Al-Haidar, Universitas Multimedia Nusantara.

2

Evaluation of The Indoor Thermal Comfort in Classrooms D1509 and D1510 at Universitas
Multimedia Nusantara, Muhammad Dzaky Al-Haidar, Universitas Multimedia Nusantara.

ENDORSEMENT PAGE

ENDORSEMENT PAGE

EVALUATION OF THE INDOOR THERMAL COMFORT IN CLASSROOMS D1509 AND
D1510 AT UNIVERSITAS MULTIMEDIA NUSANTARA


By


Full Name : MUHAMMAD DZAKY AL-HAIDAR
Student ID : 00000056432
Study Program : Engineering Physics
Faculty : Engineering and Informatics

Has been tested on Thursday, 06 June 2024
from 11.00 to 12.00, and was stated
PASSED
with the order of examiners as follows:

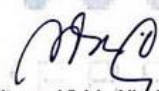
Supervisor / Mentor

Reviewer


Dr. techn. Rahmi Andarini, S.T., M. Eng., Sc
(NIDN 0328107203/NIK L00753)


Ir. Arko Djandi, M.Sc., Ph.D
(NIDN 0406086704/NIK 078764)

Head of Engineering Physics


Muhammad Salehuddin, S.T., M.T.
(NIDN 0306108702/NIK 033878)

APPROVAL OF PUBLICATION

APPROVAL OF PUBLICATION

I hereby,

Full Name : MUHAMMAD DZAKY AL-HAIDAR

Student ID : 00000056432

Study Program : Engineering Physics

Faculty : Engineering And Informatics

Type of Work : MBKM Report

Solely state that I fully grant Universitas Multimedia Nusantara to publish my work at the Knowledge Center repository system, so that it can be accessed by the Academics/Public. I also declare that there is no confidential information presented in my paper, and would never revoke this grant for any reason.

Tangerang, 16 May 2024

(MUHAMMAD DZAKY AL-HAIDAR)



PREFACE

Praise be to the completion of writing this Internship Work Report with the title: Evaluation Of The Indoor Thermal Comfort In Classrooms D1509 and D1510 at Universitas Multimedia Nusantara, carried out to fulfill one of the requirements for achieving a Strata 1 degree in the Department of Physics Engineering in Engineering and Informatics, Multimedia Nusantara University. I realize that, without help and guidance from various parties, from the lecture period to the preparation of this final assignment, it would be very difficult for me to complete this final assignment. Therefore, I would like to thank:

1. Dr. Ninok Leksono M.A, as the Rector of Universitas Multimedia Nusantara.
2. Dr. Eng. Niki Prastomo, S.T., as the Dean of the Faculty of Universitas Multimedia Nusantara.
3. Muhammad Salehuddin, S.T., M.T. as the Head of the Study Program of Universitas Multimedia Nusantara.
4. Dr. techn. Rahmi Andarini, S. T., M. Eng. Sc_ as the first Advisor who has provided guidance, direction, and motivation for the completion of this report.
5. My family who has provided material and moral support, so that I can complete this thesis.
6. MBKM Team, Indah Desri Wahyuni, Vincentius Rayza Lee, and other 2021 Physics Engineering comrades. Hopefully this report contributes as a source of information and inspiration for others.

The author also thanks all parties who have helped the author during the MBKM research process. We hope that this MBKM research report can provide benefits to the entire UMN and Physics Engineering academic community, both as information and inspiration for readers.

Tangerang, 16 May 2024



(MUHAMMAD DZAKY AL-HAIDAR)



EVALUASI KENYAMANAN TERMAL DALAM RUANG KELAS D1509 DAN D1510 UNIVERSITAS MULTIMEDIA NUSANTARA

(MUHAMMAD DZAKY AL-HAIDAR)

ABSTRAK

Kenyamanan termal adalah gambaran suatu kepuasan pikiran yang dialami manusia terhadap kondisi temperature pada lingkungan sekitarnya. Penelitian ini dilakukan memiliki tujuan untuk mengetahui tingkat kenyamanan termal pada ruangan kelas Gedung D 1509 dan 1510 pada Universitas Multimedia Nusantara dan memberikan rekomendasi untuk meningkatkan kenyamanan termal dan selalu menjaga kondisi didalam ruangan. Metode yang dipakai dalam penelitian ini adalah memberikan kuesioner kepada penghuni ruangan, pengukuran langsung, dan menggunakan sistem monitoring. Hasil yang didapatkan dalam kuesioner adalah penghuni ruangan kelas merasakan cukup nyaman, pengukuran langsung menunjukkan 26°C dan 55 % didalam ruangan kelas D 1510, 26°C dan 56 % didalam ruangan kelas D 1509, dan sistem monitoring menunjukkan hasil 25°C dan 70% pada ruangan kelas D 1510 dan 1509. Ruangan yang dilakukan penelitian sudah memenuhi standar kenyamanan termal pada SNI 03-6572-2001. Penelitian ini dilakukan pengukuran menggunakan AC menyala dan tidak ada penghuni ruangan. Penelitian ini dilakukan untuk memberikan rekomendasi kepada penghuni ruangan dan pengelola ruangan untuk selalu menjadi standar kenyamanan termal ini terjaga dan selalu membersihkan pendingin ruangan untuk memberikan kenyamanan dalam penggunaan ruangan dan menghasilkan udara yang baik dan sehat.

Kata kunci: Kenyamanan Termal, Karbon Diokasida, Suhu, Kelembaban, dan Pengukuran.

**EVALUATION OF THE INDOOR THERMAL COMFORT IN
CLASS ROOMS D1509 AND D1510 AT UNIVERSITAS
MULTIMEDIA NUSANTARA**

NUSANTARA

(MUHAMMAD DZAKY AL-HAIDAR)

ABSTRACT

Thermal comfort is a description of the mental satisfaction experienced by humans regarding the temperature conditions in the surrounding environment. This research was carried out with the aim of determining the level of thermal comfort in classrooms in Building D 1509 and 1510 at Multimedia Nusantara University and providing recommendations for increasing thermal comfort and always maintaining indoor conditions. The method used in this research is by giving questionnaires to room occupants, direct measurements, and using a monitoring system. The results obtained in the questionnaire were that the occupants of the classroom felt quite comfortable, direct measurements showed 26°C and 55% in class D 1510, 26°C and 56% in class D 1509, and the monitoring system showed results of 25°C and 70% in classroom D 1510 and 1509. The room in which the research was carried out met the thermal comfort standards in SNI 03-6572-2001. This research was measured using an AC that was on and there were no occupants in the room. This research was conducted to provide recommendations to room occupants and room managers to always maintain thermal comfort standards and always provide air conditioning to provide comfort in using the room and produce good and healthy air.

Keywords: *Thermal Comfort, Carbon Dioxide, Temperature, Humidity, and Measurement.*

TABLE OF CONTENT

NO PLAGIARISM STATEMENT	2
ENDORSEMENT PAGE	3
APPROVAL OF PUBLICATION	4
PREFACE	5
ABSTRAK	7
<i>ABSTRACT</i>	8
TABLE OF CONTENT	9
LIST OF TABLES	12
LIST OF FIGURES	13
LIST OF ATTACHMENT	14
CHAPTER I INTRODUCTION	15
1.1. Background	15
1.2. Problem Formulation	16
1.3. Research Objectives	17
1.4. Research Urgency	17
1.5. Research Outputs	18
1.6. Research Benefits	18
CHAPTER II LITERATURE REVIEW	19
2.1 Literature Review	19
2.2 Basic Theory	23
2.2.1 Thermal Comfort	23
2.2.2 Thermal Comfort Standard	23
2.2.3 Predicted Mean Vote (PMV)	27
2.2.4 Adaptive Thermal Comfort	28
2.2.5 Sick Building Syndrome (SBS)	28

CHAPTER III RESEARCH METHODS	30
3.1 Research Method	30
3.2 Research Stages	30
3.3 Data Collection Technique	31
3.4 Data Analysis Technique.....	31
CHAPTER IV RESULT AND DISCUSSION	32
4.1 Questionnaire analysis.....	32
4.1.1 Gender	32
4.1.2 Room Type.....	33
4.1.3 Duration of Room Use	33
4.1.4 Room Temperature.....	34
4.1.5 Room Humidity.....	35
4.1.6 Comfort Level	36
4.1.7 Room Sketch	36
4.1.8 Questionnaire Results Table	38
4.2 Comparative Analysis	38
4.2.1 Correlation of Gender and Temperature	39
4.2.2 Correlation of Gender and Humidity	40
4.2.3 Correlation Between Indoor Temperature Condition Gender.....	42
4.3 Analysis of Measurement results	43
4.3.1 Description of The Measurement Room Plan.....	44
4.3.2 Analysis of Class Room Measurements in Building D 1510.....	46
4.3.3 Analysis of Class D1509 Room Measurements.....	47
4.4 Analysis of Monitoring Results.....	48

4.4.1	Analysis of Temperature Monitoring Systems Results.....	48
4.4.2	Analysis of Humidity Monitoring Results	50
4.4.3	Analysis of Carbon Dioxide (CO ₂) Monitoring Results	51
4.5	PMV Analysis	53
CHAPTER V CONCLUSION AND RECOMMENDATION.....		54
5.1	Conclusion.....	54
5.2	Suggestion	55
REFERENCE.....		56
ATTACHMENT		59



LIST OF TABLES

Table 1.1 Thermal Comfort Limits According to SNI 03-6572-2001	16
Table 2.1 Literature review	19
Table 2.2 Acceptable Temperature And Relative Humidity Based On SNI 03-6572-2001 [27].	26
Table 2.3 Average Environmental Ergonomic Parameter Data [30]	27
Table 4.1. Questionnaire Results	38
Table 4.2. Measurement Results of Classroom D1510.....	47
Table 4.3. Measurement Results of Classroom D1509.....	47



LIST OF FIGURES

Figure 2.1 Acceptable operating temperature and humidity range for a room that meets the criteria in a room with 80% occupation and air speed not exceeding 0.2m/s [26].	25
Figure 2.0.2. Image of the need to increase air velocity to compensate for the increase in dry temperature [7].	26
Figure 3.0.1 The research work will be depicted in a flow chart in	31
Figure 4.1. Percentage of Female And Male As The Respondent	32
Figure 4.2. Percentage of Respondent in Each Room.	33
Figure 4.3. Percentage of Respondent Duration of Use	34
Figure 4.4. Percentage of Respondent Indoor Temperature Level	35
Figure 4.5. Percentage of Respondent Indoor Humidity Level	35
Figure 4.6. Percentage of Respondent Comfort Level	36
Figure 4.7. Percentage of Respondent Room Sketch	37
Figure 4.8. No of Male Respondents VS Temperature	40
Figure 4.9. No of Female Respondents VS Temperature	40
Figure 4.10. No of Male Respondent VS Humidity	41
Figure 4.11. No of Female Respondent VS Humidity	42
Figure 4.12. No of Male Respondent VS Comfort Level	43
Figure 4.13. No of Female Respondent VS Comfort Level	43
Figure 4.14. Description of Building D 1509 and D 1510 Classrooms	44
Figure 4.15. Measurement Point Classroom D1509	45
Figure 4.16. Measurement Point Classroom D 1510	46
Figure 4.17. Results of Monitoring System 22 April 2024 – Temperature	49
Figure 4.18. Results of Monitoring System 23 April 2024 – Temperature	49
Figure 4.19. Result of Monitoring System 22 April 2024 – Humidity	50
Figure 4.20. Result of Monitoring System 23 April 2024 – Humidity	51
Figure 4.21. Result of Monitoring System 22 April 2024 – CO2	52
Figure 4.22. Result of Monitoring System 23 April 2024 – CO2	52

LIST OF ATTACHMENT

ATTACHMENT 1 MBKM CARD 01 (COVER LETTER)	59
ATTACHMENT 2 MBKM CARD 02 (PROGRAM TRACK 01 CARD)	60
ATTACHMENT 3 MBKM CARD 03 (DAILY TASK).....	61
ATTACHMENT 4 MBKM CARD 04 (VERIFICATION).....	70
ATTACHMENT 5 MBKM ACCEPTANCE CARD (LOA)	71
ATTACHMENT 6 TURNITIN CHECKING RESULT.....	72
ATTACHMENT 7 POSTER MBKM.....	78

