



**THERMAL COMFORT EVALUATION AT THREE NON AIR
CONDITIONED PRE SCHOOL IN MELAKA USING CBE TOOL**



**BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY
(AIR CONDITIONING AND REFRIGERATION SYSTEMS) WITH
HONOURS**

2022



**Faculty of Mechanical and Manufacturing Engineering
Technology**



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CONDITIONED PRE SCHOOL IN MELAKA USING CBE TOOL**

Nur Nabilah Binti Mohd Ishak

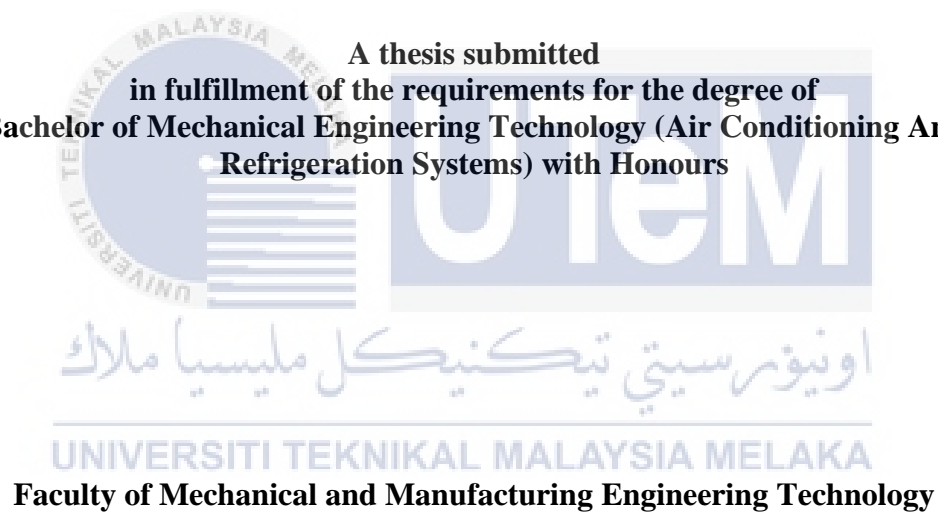
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NUR NABILAH BINTI MOHD ISHAK

A thesis submitted
in fulfillment of the requirements for the degree of
**Bachelor of Mechanical Engineering Technology (Air Conditioning And
Refrigeration Systems) with Honours**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this Choose an item. entitled “ Thermal Comfort Evaluation At Three Non Air Conditioned Pre School In Melaka Using CBE Tool ” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Air Conditioning And Refrigeration System) with Honours.

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DEDICATION

To my beloved parents Mohd Ishak Bin Mohd Yunus and Kalsom Binti Badrus. Thank you for helping me to shape my life with positivity and passion. Without you, I'd never been the person I am today. Thank you for always supporting me in all the good and bad times. When the world closed its doors on me, you both opened your arms for me. When people shut their ears for me, you both opened your hearts for me. Thanks for always being there for me and making me believe that i can do everything and anything in life. In addition, I would like to express my heartfelt gratitude to my supervisor, Ts. Dr. Amir Abdullah Bin Muhamad Damanhuri, and my friends for being a part of this journey, and I wish everyone the best of luck in their future endeavours.



ABSTRACT

Thermal comfort is a study of indoor comfort level experienced by the occupants in a room. This study involved 47 total students from different preschools. A study of thermal comfort towards preschools students were conducted in three different locations in Malacca. The purpose of this study is to determine the suitable condition for the students to feel comfortable during learning process. This research is focused on the evaluation and monitoring the thermal comfort level in three different preschools in Malacca which are Tadika Kemas Rumah Pangsa Kampung Padang, Tadika Kemas Kampung Padang A and Tadika Kemas Kampung Padang B. The factors that contributed thermal comfort towards the students were identified first. The monitoring and evaluation of thermal comfort parameters was done by using TSI VelociCalc and data obtained will be analyzed by using CBE Thermal Comfort Tool. The finding of this study reveals that the factors of thermal comfort towards occupants consists of two factor which are environmental factor and personal factor. It has been found that the value of PMV and PPD of these preschools does not comply that standard and above the acceptable range recommended by ASHRAE 55 - 2010 as well as Industry Code of Practice Indoor Air Quality, DOSH Malaysia (2010). Besides that, it has been found that the value of air temperature is increase as the time increases while the amount dust particles is irregular but it is increasing over time. The value of clothing insulation and metabolic rate effect the thermal comfort towards the students. It reveals that the lower the value of clothing insulation and metabolic rates, the more comfortable the students will be. The range of clothing insulation should be between 0.5 and 1.0, while the value of metabolic rates should be determined by the activities that they involved in. Ventilation of is important to improve the indoor air quality and productivity of the students during leaning process. Meanwhile, the data obtained from the survey shown most of students felt comfortable during learning process in the preschools. The result obtained prove that the feedback that the students gave is not significance with the ASHRAE standard.

ABSTRAK

Keselesaan terma ialah kajian tahap keselesaan dalaman yang dialami oleh penghuni di dalam sesebuah bilik. Kajian ini melibatkan 47 orang murid daripada prasekolah yang berbeza. Kajian keselesaan terma terhadap murid prasekolah telah dijalankan di tiga lokasi berbeza di Melaka. Kajian ini bertujuan untuk menentukan keadaan yang sesuai untuk pelajar berasa selesa semasa proses pembelajaran. Penyelidikan ini tertumpu kepada penilaian dan pemantauan tahap keselesaan terma di tiga prasekolah yang berbeza di Melaka iaitu Tadika Kemas Rumah Pangsa Kampung Padang, Tadika Kemas Kampung Padang A and Tadika Kemas Kampung Padang B. Faktor-faktor yang menyumbang keselesaan terma terhadap pelajar dikenal pasti terlebih dahulu. Pemantauan dan penilaian parameter keselesaan terma dilakukan dengan menggunakan TSI VelociCalc dan data yang diperolehi akan dianalisis menggunakan CBE Thermal Comfort Tool. Dapatan kajian ini mendedahkan bahawa faktor keselesaan terma terhadap penghuni terdiri daripada dua faktor iaitu faktor persekitaran dan faktor peribadi. Didapati nilai PMV dan PPD prasekolah ini tidak mematuhi piawaian tersebut dan melebihi julat yang boleh diterima yang disyorkan oleh ASHRAE 55 -2010 serta Kod Amalan Industri Kualiti Udara Dalaman, DOSH Malaysia (2010). Selain itu, didapati bahawa nilai suhu udara meningkat apabila masa meningkat manakala jumlah zarah habuk adalah tidak teratur tetapi ia meningkat dari semasa ke semasa. Nilai penebat pakaian dan kadar metabolisme mempengaruhi keselesaan terma terhadap pelajar. Ia mendedahkan bahawa semakin rendah nilai penebat pakaian dan kadar metabolisme, semakin selesa pelajar. Julat penebat pakaian hendaklah antara 0.5 dan 1.0, manakala nilai kadar metabolisme hendaklah ditentukan oleh aktiviti yang mereka terlibat. Pengudaraan adalah penting untuk meningkatkan kualiti udara dalaman dan produktiviti pelajar semasa proses bersandar. Sementara itu, data yang diperolehi daripada tinjauan menunjukkan kebanyakan pelajar berasa selesa semasa proses pembelajaran di prasekolah. Keputusan yang diperolehi membuktikan bahawa maklum balas yang diberikan oleh pelajar adalah tidak signifikan dengan piawaian ASHRAE.

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TABLE OF CONTENTS

	PAGE
DECLARATION	
APPROVAL	
DEDICATION	
ABSTRACT	i
ABSTRAK	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	viii
LIST OF SYMBOLS AND ABBREVIATIONS	x
LIST OF APPENDICES	xi
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	4
1.3 Research Objective	5
1.4 Scope of Research	5
1.5 Significance of Study	6
CHAPTER 2 LITERATURE REVIEW	7
2.1 Introduction	7
2.2 Preschools in Malacca	7
2.3 Description of Thermal Comfort	9
2.4 Factors that affect the thermal comfort	11
2.5 Indoor Air Quality (IAQ)	16
2.6 Effects of thermal comforts towards the occupants	17
2.6.1 Decreased productivity	17
2.6.2 Poor performance and health psychology	18
2.7 Thermal comfort model	19
2.7.1 Fanger model	19
2.8 CBE Thermal Comfort Tool	22
CHAPTER 3 METHODOLOGY	24
3.1 Introduction	24
3.2 Research design	24

3.3	Research Flow	25
3.4	Site visit selection.	27
3.5	Indoor sampling	32
3.6	Software (CBE Thermal Comfort Tool)	33
3.7	Instrumentation	35
3.8	Data Collection Technique	35
	3.8.1 Pilot Study	36
	3.8.2 Questionnaire	36
	3.8.3 Area Monitoring	36
	3.8.4 Background Information of Respondents	38
3.9	Data Analysis	39
3.10	Calibration and Quality Control	39
3.11	Study Ethics	40
CHAPTER 4	RESULT AND DISCUSSION	41
4.1	Introduction	41
4.2	Walkthrough Observation	41
4.3	Air Temperature, Relative Humidity and Air Velocity	42
	4.3.1 Air Temperature (°C)	42
	4.3.2 Relative Humidity (%)	43
	4.3.3 Air Velocity (m/s)	44
4.4	Relationship between PMV and PPD using CBE Tool	45
	4.4.1 Correlation between CBE Tool and Questionnaire	52
4.5	Environmental Factor Monitoring	54
	4.5.1 Correlation between Air Temperature (°C) and Relative Humidity (%)	54
	4.5.2 Correlation between Air Velocity (m/s) and Amount of Dust Particles (PM)	58
4.6	Personal Factor Monitoring	63
	4.6.1 Characteristic of Clothing Insulation	63
	4.6.2 Relationship between temperature, clothing insulation and metabolic rate	65
4.7	Evaluation of the Psychological Effects for Thermal Comfort Among Preschools Students	67
4.8	Summary	69
CHAPTER 5	CONCLUSION AND RECOMMENDATION	71
5.1	Conclusion	71
5.2	Recommendations	73
	REFERENCES	74
	APPENDICES	79

LIST OF TABLES

TABLE	TITLE	PAGE
Table 1.1	Basic educational information in Malaysia and Malacca	3
Table 1.2	Basic preschool information in Malaysia and Malacca	3
Table 2.1	Undergarments in clo values	14
Table 2.2	Garments checklist and insulation (clo) values	15
Table 2.3	Acceptable range fro specific physical parameters	17
Table 2.4	ASHRAE seven - point thermal sensation scale	20
Table 3.1	Specifications of layout building of Tabika Kemas Rumah Pangsa Kampung Padang	28
Table 3.2	Specifications of layout building of Tabika Kemas Kampung Padang A	30
Table 3.3	Specifications of layout building of Tabika Kemas Kampung Padang A	31
Table 3.4	Recommended minimum number of sampling point for indoor air quality assessment	33
Table 3.5	Measuring instruments	35
Table 3.6	Backgroun information of respondents	38
Table 4.1	Result of PMV and PPD for every 1 hour at preschool A	48
Table 4.2	Result of PMV and PPD for every 1 hour at preschool B	50
Table 4.3	Result of PMV and PPD for every 1 hour at preschool C	52
Table 4.4	The minimum, maximum and average of air temperature and relative humidity at preschool A	55

Table 4.5	The minimum, maximum and average of air temperature and relative humidity at preschool B	56
Table 4.6	The minimum, maximum and average of air temperature and relative humidity at preschool C	57
Table 4.7	The minimum, maximum and average of air temperature and relative humidity at preschool A	59
Table 4.8	The minimum, maximum and average of air temperature and relative humidity at preschool B	60
Table 4.9	The minimum, maximum and average of air temperature and relative humidity at preschool C	62
Table 4.10	Students condition during learning process in preschool A	67
Table 4.11	Students condition during learning process in preschool B	68
Table 4.12	Students condition during learning process in preschool C	68

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1	Basic educational information in Malaysia	3
Figure 1.2	Basic educational information in Malacca	4
Figure 2.1	Children (under age 18 years), by state, Malaysia, 2020	8
Figure 2.2	Number of registered child care by state, Malaysia 2018 and 2019	9
Figure 2.3	Factors that influence thermal comfort	12
Figure 2.4	Insulation of clothing clo units	14
Figure 2.5	Typical metabolic rates for activity	16
Figure 2.6	PPD as function of PMV	22
Figure 2.7	CBE Thermal Comfort Tool home page	23
Figure 3.1	Research flow chart	26
Figure 3.2	Layout building for Tabika Kemas Rumah Pangsa Kampung Padang	27
Figure 3.3	Location of Tabika Kemas Rumah Pangsa Kampung Padang	28
Figure 3.4	Layout building for Tabika Kemas Kampung Padang A	29
Figure 3.5	Location of Tabika Kemas Kampung Padang A	29
Figure 3.6	Layout building for Tabika Kemas Kampung Padang B	30
Figure 3.7	Location of Tabika Kemas Kampung Padang B	31
Figure 3.8	PMV method selection	34
Figure 3.9	TSI Velocicalc	37
Figure 3.10	TSI Dust Trax	37
Figure 4.1	Location of Dust Trax and Velocicalc during collection of data	42

Figure 4.2	Air temperature value at different preschools	43
Figure 4.3	Relative humidity value at different preschools	44
Figure 4.4	Air velocity value at different preschools	45
Figure 4.5	Result when the data analyzed usig CBE Thermal Comfort Tool	47
Figure 4.6	PMV and PPD value on PPD curve for preschool A	47
Figure 4.7	Result when the data analyzed usig CBE Thermal Comfort Tool	49
Figure 4.8	PMV and PPD value on PPD curve for preschool B	49
Figure 4.9	Result when the data analyzed usig CBE Thermal Comfort Tool	51
Figure 4.10	PMV and PPD value on PPD curve for preschool C	51
Figure 4.11	Air temperature value at different preschools	53
Figure 4.12	Correlation between air temperature and relative humidity in preschool A	55
Figure 4.13	Correlation between air temperature and relative humidity in preschool B	56
Figure 4.14	Correlation between air temperature and relative humidity in preschool C	58
Figure 4.15	Correlation between air velocity and amount of dust particles in preschool A	59
Figure 4.16	Correlation between air velocity and amount of dust particles in preschool B	61
Figure 4.17	Correlation between air velocity and amount of dust particles in preschool C	62
Figure 4.18	Type of clothing at different preschools	64
Figure 4.19	Level of comfort at different preschools	66

LIST OF SYMBOLS AND ABBREVIATIONS

ASHRAE	-	American Society of Heating, Refrigeration and Air- Conditioning Engineers
PMV	-	Predicted Mean Vote
PPD	-	Predicted of Percentage Dissatisfied
Ta	-	Air temperature (°C)
V	-	Air velocity (m/s)
RH	-	Relative humidity (%)
Tmrt	-	Mean Radiant Temperature (°C)
DOSH	-	Department of Occupational Safety and Health
MOE	-	Ministry of Education
IAQ	-	Indoor Air Quality
SET	-	Standard Effective Temperature (°C)
CBE	-	Centre For The Built Environment
clo	-	Unit of clothing insulation (m ² .K/W)
SPSS	-	Statistical Package for the Social Sciences
ICOP	-	Industry Code of Practice

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
APPENDIX A	Gantt Chart Final Year Project 1	79
APPENDIX B	Gantt Chart Final Year Project 2	80
APPENDIX C	Data collection based on different parameters using TSI Velocicalc for preschool A	81
APPENDIX D	Data collection of amount of dust particles using TSI Dust Trax for preschool A	83
APPENDIX E	Data collection based on different parameters using TSI Velocicalc for preschool B	85
APPENDIX F	Data collection of amount of dust particles using TSI Dust Trax for preschool B	87
APPENDIX G	Data collection based on different parameters using TSI Velocicalc for preschool C	89
APPENDIX H	Data collection of amount of dust particles using TSI Dust Trax for preschool C	91
APPENDIX I	Questionnaire distribution towards students	93
APPENDIX J	Photos taken during conducting the study at different preschools	95
APPENDIX K	Permission letter to conduct research at Tabika KEMAS	97
APPENDIX L	Turnitin	98

CHAPTER 1

INTRODUCTION

1.1 Background

Educational is an important thing in our life. It is because it is the process of learning to get the knowledge, skills or habits. Formal education in Malaysia can be divided into stages such as kindergarten, primary school, secondary school, college and university. There are many educational institutions that students can choose from whether in private or government institution.

School is a place for educational building for student to get knowledges, hubs of social activities and gains the interaction between students towards the surroundings. It is important for students to get a very good environment such as comfortability. Students around the age of 2 – 26 years old spend a lot of their waking hours in a classroom (considered age for kindergarten to university) according to (De Dear et al., 2015). The minimum hours for students to stay at their school is 7 hours. Which is from 7:30 a.m. to 2:30 p.m. and it is mostly followed by compulsory co – curricular activities or extra class. Each school has their own schedule that need to be followed by the students.

Malacca is located in south region of Malaysia. The tropical climate in Malaysia is hot and humid at all year. Due to some reason, the climate has change and the effects of it is continuous rising temperature, extreme weather events and public health in Malaysia is decreasing (Tang, 2019). This problem occurs due to activities that causing the global warming and green house effects which are burning fossil fuels, cutting down farming and

farming livestock. In addition, a curriculum is designed based on local climate condition according to (Perkins et al., 2018). In a classroom, the performance of the students such as attention, concentration and learning affected by the surrounding environment. It does not matter whether in primary or secondary school or even universities.

In Malaysia, educational institution need to meet the basic requirements of satisfaction comfort level such as good environment to improve the student performance (Mazlan et al., 2020). The comfort level can be improved between the performance and environment conditions. A strategic position to build up a school building is also a major factor where students can learn comfortably and focus when the teaching and learning process is being carried out. This is because the surrounding environment can influence students' behaviors and their mood to act. When students feel comfortable, they will stay focused and the motivation to study and it will help them to absorb more information. In addition, a school environment that is calm, clean and attractive can attract students to study well.

According to Ministry of Education (MOE), the total numbers of schools in Malaysia are 10,225 includes the preschools, primary schools and secondary schools. The total students throughout the year are 4,795,600 and the teachers are 413,022. As stated in the Figure 1.1, Figure 1.2, Table 1.1 and Table 1.2 below shows the basic educational information in Malaysia and basic preschool information in Malaysia.

Table 1.1 Basic educational information in Malaysia and Malacca (MOE,2021)

	No. of school	No. Of teacher	No. of student	No. of classroom
Malaysia	10,225	413,022	4,795,600	185,986
Malacca	315	137,767	149,915	6231

Table 1.2 Basic Preschool information in Malaysia and Malacca (MOE,2021)

	No. of school	No. of teacher	No. of student	No. of classroom
Malaysia	6,214	9,294	207,828	9,677
Malacca	170	246	5,621	246

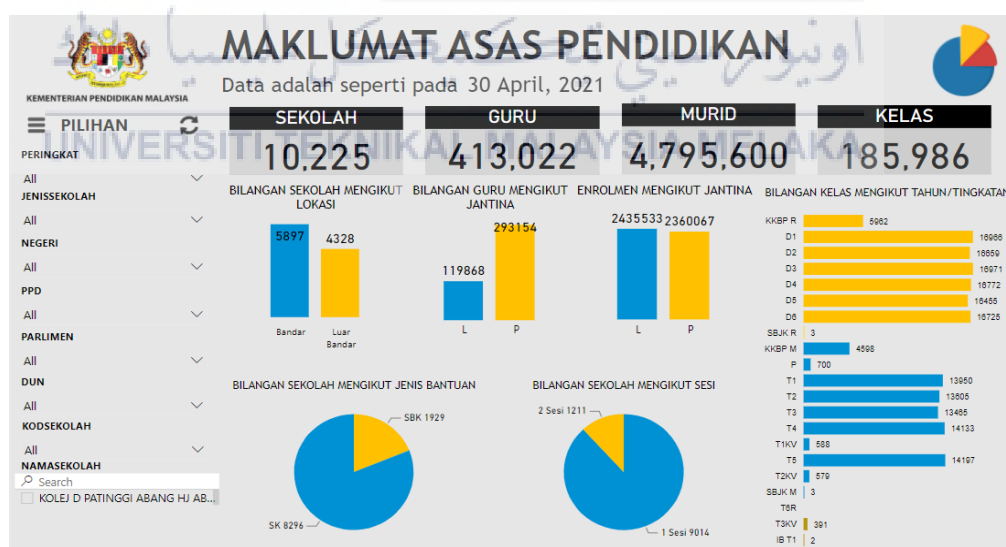


Figure 1.1 Basic educational information in Malaysia (Sources:

<https://www.moe.gov.my/>)

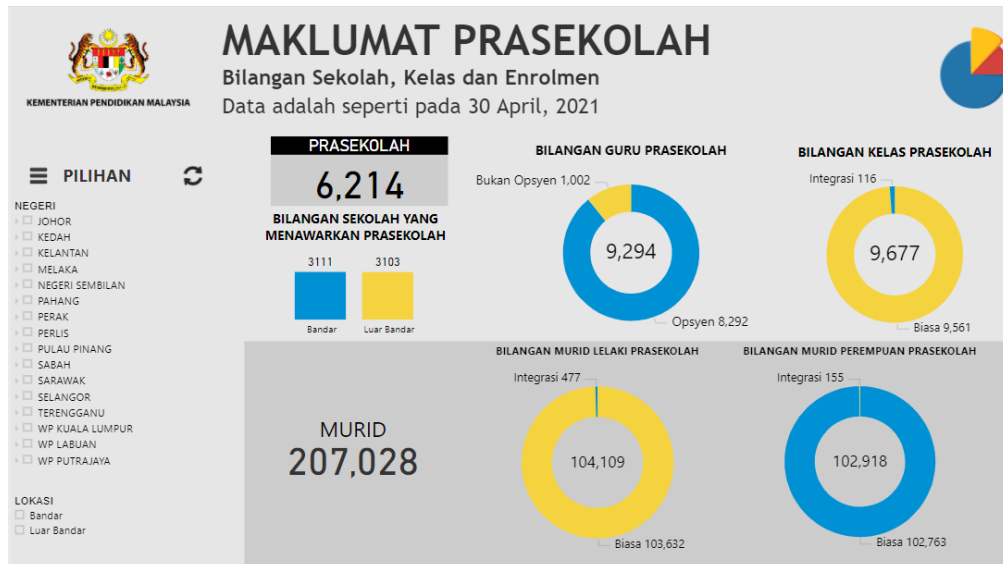


Figure 1.2 Basic educational information in Malacca (Sources:

<https://www.moe.gov.my/>)

1.2 Problem Statement

Classrooms are designed for students where they spend most of their time during their teaching and learning process in school. Usually, teachers will apply all the theories and the applications between students in the classroom. During studies, students need comfortable surroundings to maximize their learning productivity performance in their school. Thermal comfort of the surrounding is very important because if there is lack of comfort it can cause an 'environmental stress' and it will produce a negative trend (Nico et al., 2015). To avoid that problem, we need to have an indoor comfort towards the school buildings especially the classroom.

Research has been reported that the indoor environment quality often inadequate in primary school. The temperature in classroom has a strong impact in learning according to (Wargoeki et al., 2020). Moreover, the air quality of classroom may affect the cognitive skills as the student cannot concentrated and distracted with the work they were supposed to

do. Student's performance can be reduced because the teachers could not teach effectively as they need comfortable surroundings. The changes of climate and weather causing thermal comfort is hard to be achieved. The tropical climate in Malaysia is hot and humid so the temperature that were accepted for the comfort towards humans is between 27.1°C and 29.3°C.

1.3 Research Objective

In this study, there are a few targets to be given fully attention to achieve these objectives.

- a) To investigate selected parameter of indoor thermal data at three preschools in Malacca.
- b) To determine indoor thermal comfort PMV and PPD level using CBE Tool.

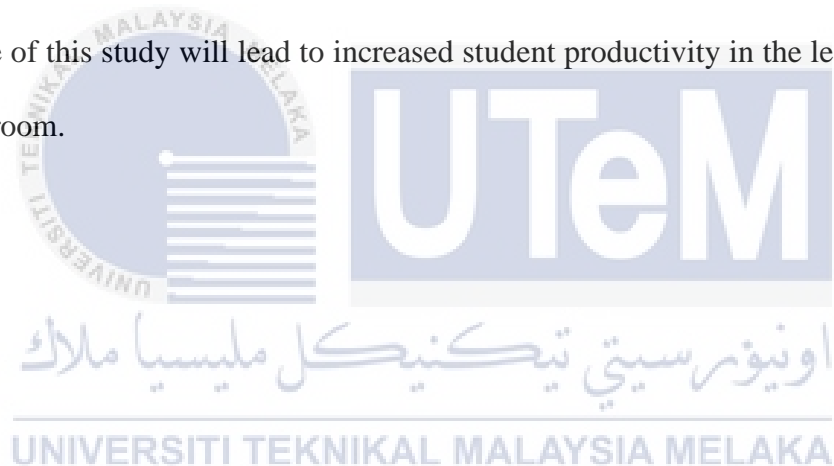
1.4 Scope of Research

The scope of this research is to analyze on how the thermal comfort correlated with the occupants in non air conditioned classroom at different preschools and it will be held in Malacca. In this study, three different locations of preschools will be selected which are Tabika Kemas Rumah Pangsa Kampung Padang, Tadika Kemas Kampung Padang A and Tabika Kemas Kampung Padang B. The classroom will be occupied with the students and other occupants during the discussion or learning process. Furthermore, in this study the total students that will be involved in a classroom are about 15 to 20 students in each preschool and the mechanism that were used is fan. The parameter that will be used in this study based on thermal comfort are air temperature (T_a), mean radiant temperature (T_{mrt}), air velocity (V) and relative humidity (R_h). In addition, the predicted mean vote (PMV) index and

predicted percentage dissatisfied (PPD) index will be calculated by using CBE thermal comfort tools. The software that will be used is the latest edition which is version: 2.3.2.

1.5 Significance of Study

Nowadays, thermal comfort is important to enhance the quality of life and health towards everyone especially students. This element is needed for better surroundings during the process of teaching and learning. The results of this study are expected to provide ideas for stakeholders to improve the infrastructure of the kindergarten in the future. The data shows that high ambient temperature in the classroom will cause students to loss focus while learning. It can cause their academic achievement will be affected. In conclusion, the significance of this study will lead to increased student productivity in the learning process in the classroom.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Thermal comfort and Indoor Air Quality (IAQ) is a remarkable issue that were frequently arise related to comfortability (Merabtine et al., 2018). Comfort is the most important aspect for the environment and occupants. It is very crucial because people need comfort in doing an activity no matter where they are, whether indoor or outdoor. For example, students at school, employees working in the office or a rider. They need suitable attire to make them feel comfortable. The building where the occupants stay in is very important to have a good environment. For example, suitable temperature is needed for them to be comfortable in the building area. In this chapter it will cover the summarized of previous research and information about thermal comfort and Fanger model.

2.2 Preschools in Malacca

In Malaysia, the total of preschools in this country are 6,214 while in Malacca 170 and it include in urban and rural area according to Ministry of Education, 2021. The purpose of the preschool is to provide the learning experience towards the students to develop their basic skills such as in learning and exploring before entering primary school. The age of administration for the student to enter the preschools are starting from four years old to six years old based on Ministry of Education,2021. This type of institution basically based on two sectors which are government institution and private institution. Figure 2.1 below show the percentage of children (under age 18 years), by state in Malaysia.