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Article

Perception of Lecturers and Students Regarding the Illuminance in the Lecture Theatres and Tutorial Rooms: Case Study in Universiti Tunku Abdul Rahman (UTAR)

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Abstract. Even though artificial lighting is widely used nowadays, it has several negative impacts on human health. Therefore, this paper reported research that comparing the illuminance level in the learning environment in UTAR and recognizing the users' insights on the illuminance level. Lux meter and questionnaires were used for data collection. Questionnaires were administered to 312 respondents. The results show that the illuminance level in some of the tutorial rooms is too bright and left on even when the rooms are empty. From the descriptive analysis, it is found that almost all the respondents are satisfied with the illuminance level in both research venues. Based on the t-test, it is found the significance for pair 1 and pair 2 is greater than 0.05. Hence, there is no similarity between both research venues. Pair 1 is about the lighting condition preferred by the respondents, while pair 2 is about the condition in both research venues which includes the existence of glaring vision, headache, eye tiredness, and conditions that affect student performance. This paper concludes by suggesting that individual switches be provided for each of the bulbs.

Keywords: Energy saving, illuminance, learning environment, perception, university.

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1. Introduction

Previously, natural lighting was the major light source in buildings before the creation of artificial lighting in the year 1879 [1]. Previously, artificial lighting was mostly utilized to compensate for natural lighting where it is difficult to obtain natural lighting, especially during the winter seasons. In recent days, artificial lighting has become the primary resource to brighten working spaces and homes. Though artificial lighting is considered the greatest invention of humankind, there is a growing concern about the side effects of artificial lighting systems [1].

Indoor illumination is one of the vital elements in the Indoor Environment Quality (IEQ) assessment. Indoor Environment Quality was established to create an appropriate indoor environment that strengthens the occupant's health, well-being, and comfort. IEQ prioritizes the user's health by assessing the environmental aspects including illumination quality, acoustical quality and visual, thermal comfort, and air quality. The illumination quality is one of the key considerations in IEQ measurement that should not be forgotten [2].

Adding to this, 21% of green building evaluation criteria for non-residential buildings, namely academic institutions are based on IEQ elements. However, IEQ is least considered as the main priority in most management and development planning. Nowadays, the majority of the people spend most of their time indoors, whether it can be in the school, office or homes. Therefore, the indoor environment surely affects their health and well-being. A decent illumination performance contributes to emotional and physical benefits by reducing overall energy utilization. Hence, the indoor illumination should be kept at the optimal level [3].

By enhancing natural lighting, students' attention, intellectual presentation, alertness span, and attitudes in the learning venues can be improved [4]. Daylight distributions are influenced by the depth of the learning venues. For example, if the Window-to-Floor Ratio (WFR) is greater than 20%, the sunlight supply is unacceptable because of its larger depth of the classroom's layout design. Arabi, et al. [5] stated that there are no specific guidelines on the preferred illuminance levels and discomfort level for students. Table 1 contains the guidelines for the ranges of office illuminance levels that are refereed for schools and colleges.

Many reasons explain pondering daylight as a valuable light source in almost every type of buildings, especially in learning institutions. The solid reason for selecting natural light is because the quality of natural light is better than any artificial lighting for reading and writing purposes [5]. The luminous efficiency of daylight in Malaysia is outstanding and could serve most of the required luminosity during the day [5]. If the students have excellent daylighting in their learning institution's interior environment, they will excel in their academics. Insufficient learning environment brightness, especially on the working desk level where most of the reading and writing activities will take place leads to weak attention and poor performance. Previous research revealed that a poorly designed classroom affects the student's grades. In learning institution-building daylight is a vital design criterion rising from human requirements and environmental sustainability [6].

Table 1. Illuminance level based on jobs [5].

Job	Illuminance Level (foot candles)	Illuminance level (lux)
Reading printed material	30	323
Reading pencil writing	70	753
Reading good duplicated materials	30	323

1.1. Standards and Guidelines

Based on several guidelines and standards, the minimum glazing factor of 2% should only be highlighted when 75% of occupied areas in a building space are occupied to carry out activities such as reading and writing [7]. Generally, intensity and illuminance are spotted by the accessibility of the daylight through the reflection of the size of a window opening, furniture, office material, and layout settings [7].

Many daylight studies were carried out in a non-religious school used table with 800mm to 900mm working plane height [8]. Different standards and guidelines suggested that the appropriate illuminance level for any learning spaces should be between 300 lux to 500 lux. Almost all the public schools in Malaysia had insufficient illuminance levels in the classrooms, whereby only 25 percent of the selected public schools managed to achieve the recommended standards and guidelines. Other than that, due to the insufficient architectural standards and improper designs, it is not difficult to find a school building that has poor performance and energy efficiency in Malaysia. Based on daily activity, all the lights will usually be switched on throughout the day even during recess time. By doing this, the heat in the building will be increased and there will be a need to use an air conditioning system to lower the temperature to provide a comfortable environment. Other than health, there are other benefits provided by suitable daylight such as lowering the cooling and lighting energy expenses. Cooling cost can be lowered with a suitable daylight design for a building which will lessen the overall heat inside the building [6].

Each country has recognized a customize illuminance standard based on its unique climate and geographic conditions. For example, in Singapore, SS531:2006 was formed by the Technical Committee on Lamps and Related Equipment, under the horizon of the Electrical and Electronic Standards Committee, the suggested range

of illuminance in the classroom is ranged between 300-500 lux where else in the United Kingdom and the United States, the suggested design illuminance for different types of the classroom as in the Code for Interior Lighting ranges from 300 lux to 500 lux. Illuminance level recommended in GB50034-2204 Standard for lighting design of buildings in China is 300 lux where else in Japan, the recommended illuminance level for classrooms is 200 lux to 750 lux. In Indonesia, the recommended illumination level for the classroom is within 250 lux to 300 lux under the Indonesian National Standard SNI 03-6197-2000. In Malaysia, the recommended illuminance level is 300 lux to 500 lux under Malaysia Standard MS1525:2007 Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings [2].

The recommended illuminance level for the learning environment by various standards and guidelines is shown in Table 2. Malaysian standards, IESNA and Zumtobel recommend illuminance level in the range between 300 lux to 500 lux where else Philippines' Education Facilities Manual (EFM) recommended a lower range between 215 lux to 430 lux [8]. Illuminance level recommended by Malaysian standards and guidelines was used as the benchmark for this study.

Table 2. Standards and guidelines on illuminance level [8].

Standards and Guidelines	Malaysia			Others		
	OSHA	MS1525	JKR	Zumtobel	EFM	IESNA
General Teaching Area	300	300-500	300-500	300	215-430	300-500
Library		300-500	300			300

1.2. Effects of Poor Illuminance

Inadequate natural lighting often causes visual exhaustion or eye strain because the normal fit eyes cannot be overstrained. Lack of lighting can damage the eye tissues. Poor lighting effect indirectly to the natural reaction such as inadequate luminance or concealing reflections like getting closer to the specific job or changing the different direction by implementing uncommon positions that lead to other types of stress, such as back pain. In the learning institutions like schools and colleges, poor lighting causes visual discomfort [3].

According to Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings-Code of Practice (MS1525:2014), lighting should provide an appropriate visual environment in a specific space for example adequate and appropriate lighting for performing wide of a range of regular jobs and for the creation of wanted looks. The designated color rendering index (CRI) for a specific job should also be prudently decided concurrently with the lighting intensity [9]. Indoor spaces will be frequently complained by the users, especially on their lighting distraction and high brightness which can cause visual discomfort and reduce their performance [10].

The two factors which have more effects on humans' moods are the bright illuminance together with the low color temperature turns people to feel warmer and uneasy, while dim illuminance together with high color temperature may turn someone to feel unhappy and uneasy [11, 12]. Indirect lighting or ambient lighting turns someone to feel nervous, tense, and exhausted where else people can perform better indirect lighting. Hence, it can be concluded that direct lighting creates positive moods and indirect lighting creates negative moods [13, 14]. [15, 16] stated that students become calm and attentive in the classroom activities in the dim classroom compared to a bright classroom. Many prefer to work in daylight compared to artificial lighting because it is more pleasant, this is the main reason why people like to sit at the table next to the windows which have direct sunlight access [17].

Previous research shows that many suffered from eyes strain due to lack of illuminance level and lack of interest if working in a windowless room, natural lighting is always has been considered as the best source of lighting because it promotes the users' performance, can stay at work longer without getting exhausted and lesser absenteeism [18, 19, 20, 21, 22].

There is similar research that was conducted in public universities in Malaysia to determine the lighting performance in the classrooms. The research found that not all the lux levels in the classrooms were within the standards and guidelines recommended in Malaysia. A long working hour requires better illuminance to avoid fatigue and learning inefficiency [8]. Therefore, this research aims to contrast the illuminance level in lecture theaters and tutorial rooms in UTAR and to determine the users' insights on the illuminance level in both of the research venues in UTAR. The goal of this research is to survey from two (2) dimensions which are measuring the illuminance level in the tutorial rooms and lecture theatre and to determine the perceptions of the direct users of those spaces namely lecturers and students.

2. Methodology

Primary data were collected using two methods (2) namely illuminance reading using Lux Meter and perceptions of the direct users are measured using questionnaires. This research was conducted in lecture

theatres and tutorial rooms in UTAR Kampar Campus. Twenty-two (22) lecture theatres in four (4) different blocks and eighty (80) tutorial rooms in four (4) different blocks were selected for this research. These venues are chosen due to it is frequently used by the staff and students compared to other blocks. The readings from the Lux Meter are taken inside the venues, were taken during a gloomy sky and partially cloudy condition at 12 noon. Four (4) points were selected in lecture theatres and four (4) points were selected in tutorial rooms so that experiments using Lux Meter can be performed. Initially, the research venues were divided into four equal squares so that the lighting measurement can be taken at the center of these divided areas. Lighting measurements were taken at 0.85 m above the floor level. Then readings were recorded accordingly. These measurement methods are referred to from Guidelines on Occupational Safety and Health for Lighting at Workplace [19].

Three hundred seventy-eight (378) questionnaires were administered, but only three hundred twelve (312) questionnaires were received back, therefore the rate of response is 82.54%. Among the three hundred twelve (312) respondents, two hundred sixty (260) are the students and fifty-two (52) are lecturers who are using the chosen location frequently. 176 or 56% are male respondents and 136 or 44% are female respondents. All the respondents are selected randomly, therefore there is no gender discrimination in the respondent selection process. The majority of respondents are from the Faculty of Engineering and Green Technology which is 34%, 26% of respondents are from the Faculty of Business and Finance, 21% of the respondents from the Foundation, 9% of respondents from the Faculty of Information and Communication Technology, 6% of respondents from the Faculty of Science and 4% of respondents from the Faculty of Arts and Social Science. The lux meter measurement and questionnaire were conducted in the same period, which is in the middle of the long semester of 2019. This questionnaire contains six (6) questions in Part A which is the demography section, eleven (11) questions in Part B which is true or false questions, eight (8) questions in Part C which is true or false the questions and fifteen (15) questions in Part D which is Likert scale. Scale number 1 specifies strongly disagree and scale number 5 specifies strongly agree. Only Part D will be discussed in this paper. Descriptive analysis and T-Test were used to analyze fifteen (15) questions in the questionnaires.

2.1. The Characteristics of the Lecture Theatres and Tutorial Rooms

The lecture theatres (auditorium seating) have no windows which allow natural lighting to come in. All the lecture theatres in all the blocks used in this research are sharing the same design. The white color of paint is used in this lecture theatre. Where else, the tutorial rooms have slightly different designs. Tutorial rooms in Block R and Block S are sharing the same design. Tutorial rooms in Block T and Block U are sharing the same design. Tables and chairs of the students are placed close by to the whiteboard to provide a good view to the students. Detailed specifications of the lecture theatre are shown in Table 3.

2.2. The Obstructions in the Research Venues

There are blocks adjacent to all the researched blocks that obstruct the natural lighting received from the right side of the tutorial rooms. Tall trees were planted are about 17 feet from each block. Those trees have grown up to 10 feet high and the shade from these trees is obstructing the natural lighting from the left side of the room. Due to these reasons, poor daylight illuminance was recorded in all the tutorial rooms which require artificial to be used even in the daytime. Kampar area is full of many mountains and due to this reason, heavy rain is frequent. If the sky becomes gloomy and fully overcast without any sunlight, then these rooms used in this research need to rely on artificial lightings to bright up the rooms.

2.3. The Limitations in this Research

There are several limitations while conducting this research, such as due to some of the bulbs in both lecture theatre and tutorial rooms are not functioning, therefore there will be a huge difference in the lumen (lx) collected in the rooms which have fully functional bulbs. This may raise a question of accuracy. Respondents with good vision (without wearing glasses) or short sight (be wearing glasses) were not taken into consideration for this research. The buildings used in this research were constructed in 2002 and following the wear and tear concept.

3. Results and Discussion

The result section is divided into two (2) sections which are the comparison of the illuminance level in lecture theaters and tutorial rooms and to identify the users' perceptions of the illuminance level in both lecture theaters and tutorial rooms in UTAR.

Table 3. Detail specifications of the research locations.

Location	Size of the room	Number of doors	Number of windows	Ventilation	Bulb's specification	Capacity (pax)
Lecture theatre	12225mm (length) x 21225mm (width).	3	0	No fans, operating under centralized air-conditioning units	• 40 units of 14 watts of white downlights (One 1-way switch is controlling (6) fluorescent bulbs in the downlights at once) • 4 units of 12watt of yellow highlights (One 1-way switch is controlling (4) yellow highlight bulbs at once)	150
Tutorial room (Block R and Block S)	8474mm (length) x 12225mm (width)	1	3 large panels at the back of the classroom	No fans, operating under centralized air-conditioning units	• 36 units of 14 watts of downlights • 5 rows of 6 units of 8 watts of short fluorescent LED bulbs	80
Tutorial room (Block T and Block U)	8474mm (length) x 12225mm (width)	2	• 3 large windows with 2 panels and 1 large window with 1 panel at the left side of the classroom • 3 large windows with 2 panels and 3 large windows with 3 panels at the right side of the classroom	No fans, operating under centralized air-conditioning units	• 36 units of 14 watts of downlights • 5 rows of 6 units of 8 watts of short fluorescent LED bulbs	80

3.1. Comparison of the Illuminance Level in Lecture Theaters and Tutorial Rooms in UTAR

Based on Table 4, the average readings from the lux meter in the selected lecture theatres are within the range of 300-500lux which is in the recommended category for the classroom and library in MS1525 2014 [9]. Four (4) points were selected to measure the accurate readings due to the various seating types in the lecture theatre. Four (4) different blocks were selected as samples for this research.

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Table 4. Lux meter result for lecture theatres in Block R, Block S, Block T and Block U.

			Block R		
Block R	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
RSA	365	276	223	225	272
RSB	381	371	429	421	401
RSC	433	560	364	412	442
RSD	391	281	349	319	335
RSE	381	358	225	355	330
			Block S		
Block S	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
SSA	368	423	435	350	372
SSB	350	478	450	338	388
SSC	534	323	432	352	400
SSD	433	452	305	385	378
SSE	439	358	329	468	416
			Block T		
Block T	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
TSA	448	451	382	443	431
TSB	385	435	444	373	409
TSC	366	328	405	477	394
TSD	302	400	376	394	368
TSE	379	360	484	295	380
TSF	446	424	450	338	415
TSG	303	335	432	352	356
			Block U		
Block U	**Point I**	**Point II**	**Point III**	**Point IV4**	**Average(lx)**
USA	411	414	404	443	418
USB	321	463	393	373	388
USC	326	425	346	477	394
USD	324	428	326	394	368
USE	357	475	331	295	365

Table 5, shows that the illuminance level in some of the venues in Block R, Block T, and Block U is slightly higher than the range recommended illuminance levels for classroom and library in MS1525 2014 [9]. One (1) tutorial room in Block R, four (4) in Block S, and the tutorial rooms in Block U recorded above 500lux. This reading indicates that these tutorial rooms are over illuminance and too bright. This over illuminance is caused by the usage of artificial lights compared to the natural lighting, lights which are provided are in too much of intensity and only few control switches are available in each room which makes many lights are turned on at once when the control switches are on. Some of the tutorial rooms are equipped with three (3) large window panels which can be used as a natural lighting source to substitute the artificial lighting. Switches for the electric lights can be turned off when the sun is out there to reduce the illuminance level and to reduce the utility bills. Because on one switch control six (6) bulbs at once it is quite difficult to control the illuminance level in the tutorial rooms. White bulbs used in all the lectures and tutorial rooms, light bulbs are good in terms of illuminance because it does not create any shadows but then it creates fatigue in prolonged usage. Over illuminance can be one of the causes of physical damage to the eyes, stress, anxiety, medical stress, and even psychological disorders [2].

Table 5. Lux meter result for tutorial rooms in Block R, Block S, Block T, and Block U.

		Block R			
Lower Level	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
R001	458	428	424	421	433
R002	393	326	495	375	397
R003	323	302	360	426	353
R004	442	399	402	430	418
R005	335	388	499	419	410
R006	421	324	386	446	394
R007	318	360	473	357	377
R008	326	412	442	334	379
R009	379	337	405	348	367
Upper Level	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
R101	375	329	390	314	352
R102	300	330	430	385	361
R103	430	428	389	401	412
R104	325	365	330	385	351
R105	570	532	453	473	507
R106	439	423	389	410	415
R107	338	398	430	436	401
R108	562	355	385	483	446
R109	385	460	456	463	441
R110	324	396	382	402	376
R111	330	310	420	450	378
R112	333	345	328	355	340
R113	320	356	330	332	335
R114	230	270	330	285	279
R115	313	260	335	325	308
		Block S			
Lower Level	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
S001	321	430	386	370	377
S002	331	384	412	432	390
S003	520	541	491	511	516
S004	580	521	616	533	563
Upper Level	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
S101	476	483	445	478	471
S102	690	576	658	571	624
S103	393	380	396	385	389
S104	515	550	518	508	523
S105	575	561	540	538	554
S106	393	533	545	467	485
S107	500	484	533	481	500
S108	270	428	379	328	351
S109	303	357	308	328	324
		Block T			
Lower Level	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
T001	445	487	376	388	424
T0002	521	512	469	491	498

Upper Level	Point I	Point II	Point III	Point IV	Average(lx)
T101	382	422	328	352	371
T102	332	377	354	348	353
T103	483	398	421	409	428
T104	331	395	421	418	391
T105	306	323	318	378	331
T106	341	319	333	368	340
		Block U			
Lower Level	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
U001	649	631	721	689	673
U002	632	743	628	656	665
U003	668	659	619	651	649
U004	745	608	605	699	664
U005	526	560	663	651	600
U006	531	498	605	458	523
U007	607	574	731	630	636
U008	647	650	733	626	664
U009	606	637	656	536	609
U010	622	639	692	733	672
U011	658	604	580	781	656
U012	514	603	574	489	545
U013	626	664	588	559	609
U014	689	569	528	711	624
U015	517	672	631	577	599
U016	538	641	470	665	579
U017	633	574	709	678	649
U018	604	584	532	555	569
Upper Level	**Point I**	**Point II**	**Point III**	**Point IV**	**Average(lx)**
U101	685	669	589	613	639
U102	723	610	620	567	630
U103	668	651	601	621	635
U104	583	595	672	638	622
U105	603	731	625	572	633
U106	681	677	579	541	620
U107	677	603	623	633	634
U108	640	568	656	612	619
U109	634	655	613	723	656
U110	580	567	603	741	623
U111	581	622	616	562	595
U112	606	574	621	596	599
U113	567	597	613	647	606
U114	642	633	664	645	646
U115	603	640	504	638	596
U116	630	677	597	515	605
U117	677	641	586	653	639

3.2. Descriptive Analysis for Lecturer and Student's Perception on the Illuminance Level in the Lecture Theatre and Tutorial Rooms

The reliability test Section D is shown in Table 6 and the validity test for Section D is shown in Table 7. Table 6 shows that the Cronbach's Alpha of reliability test for Section D is very high. Furthermore, Cronbach's Alpha is within 0.7 to 0.9, which means a good internal consistency.

Table 7 shows the KMO test value for Section B which is 0.819. The degree of common variance is praiseworthy as the KMO's test value is between 0.80 and 0.89. Adding to this, there is a strong relationship between the variables in Section D as Bartlett's Test of Sphericity value is lesser than 0.001.

Table 6. Cronbach's Alpha for internal validity.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.859	0.841	15

Table 7. KMO and Bartlett's Test.

KMO And Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.819
Bartlett's Test of Sphericity	Approx. Chi-Square	3927.365
	df	105
	Sig.	0.000

Based on Table 8, the lowest mean recorded is 2.10 and the highest mean is 3.77. Hence, almost all the respondents feel that the illuminance level is vital in a learning environment. The illuminance level will affect the user's presentation, attitude and health are at the highest rank and light cause headache and eye fatigue are at the lowest in the rank which is 2.10. The result also shows that almost all the respondents are satisfied with the illuminance level in both research venues. The result shows that the illuminance level in selected blocks does not create distress among the respondents. However, UTAR can still take some effort to reduce the usage of artificial lighting by restricting the use of the artificial lights during the sunny day or installing the artificial lighting with a sensor which switches off the lights when no one is in the designated room for a certain period.

Table 8. Lux meter result for tutorial rooms in Block B, Block E, Block H, and Block N.

Descriptive Statistics						
	N	Min	Max	Mean	Std. Deviation	Ranking
Illuminance is important in learning environment.	312	3	5	3.77	0.465	1
Illuminance will affect the user's performance.	312	3	5	3.68	0.499	2
Illuminance will affect the user's health.	312	1	5	3.63	0.535	5
Illuminance will affect the user's mood.	312	3	5	3.66	0.500	4
Illuminance will affect visual performance.	312	3	5	3.67	0.522	3
Satisfied the illuminance level in UTAR learning environment.	312	3	5	3.46	0.506	6
Satisfied the light colour in lecture theatre and tutorial class.	312	3	5	3.40	0.516	7
Satisfied the lighting condition in lecture theatre and tutorial class.	312	3	5	3.36	0.507	8
The light makes you feel headache.	312	1	5	2.10	0.613	13
You felt warm under the light.	312	1	5	2.14	0.628	11
You felt visual distraction during lecture theatre and tutorial class.	312	1	5	2.11	0.692	12
You felt visual discomfort during lecture theatre and tutorial class.	312	1	5	2.15	0.651	10
You felt eye fatigue during lecture theatre and tutorial class.	312	1	5	2.10	0.685	13
Your eye felt dry during lecture theatre and tutorial class.	312	1	4	2.11	0.654	12
You have difficulties in seeing an object on the screen.	312	1	5	2.17	0.710	9
Valid N	312					

Table 9 is used to determine whether is there any differences between the perception of the lectures and the students regarding the illuminance level in the lecture theatre and tutorials in the selected block. From Table 7, it is found that a paired sample test was conducted on a sample of 312 respondents to identify whether there was a statically significant similarity between tutorial class and lecture theatre. Pair 1 is about the lighting condition in the learning environment which is preferred by the respondent while pair 2 is about the condition in both of the research venues which includes the existence of glaring vision, the existence of headache, and eye tiredness, and conditions which affect student performance. According to the result, the Sig (2-tailed) for pair 1 and pair 2 is greater than 0.05. Hence, it is determined that there is no notable difference in both research venues. But, the mean difference occurs due to the users' personal preferences which difficult to determine.

Table 9. Lux meter result for tutorial rooms in Block R, Block S, Block T, and Block U.

Paired Samples Test									
		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pair 1	Tutorial class – Lecture Theatre	23.000	66.468	47.000	-574.192	620.192	0.489	1	0.710
Pair 2	Tutorial class – Lecture Theatre	-105.200	238.087	106.476	-400.823	190.423	-0.988	4	0.379

4. Recommendation and Conclusion

From the results, it is found that the average readings of illuminance level are quite high in several blocks compared to the average readings recommended for the classroom and library. Even though the result shows that the illuminance level in the sample blocks in this research did not make the respondents feel discomfort, but some effort can be taken to switch off to the lights when it is not in use. For the rooms which have high lux reading, individual switches can be provided for each of the bulbs to control the illumination level manually by the students and lecturers because currently, one (1) switch is controlling four (4) or six (6) at once. Students and lecturers can also adjust the illuminance in the specific rooms by just switching on the required bulbs only instead of switching all of them. Since all the tutorial rooms have large window panels, students and lecturers should be considering natural daylighting whenever it is possible instead of always relying totally on artificial lighting. For the lecture theatre, students and lecturers cannot adjust their level of illuminance as per their preferences since there no window panels therefore dependency on artificial lighting cannot be avoided. If the university is considering building new buildings soon, then they can consider adding more windows to allow more natural lighting into the buildings. Illuminance level not only affects the learning environment, but it also affects the mood of the students when they are trying to grasp the knowledge given by their lecturers. Generally, artificial lighting is essential on the days where the sun is not available or gloomy day, but on the other hand, over illuminance can be led several negative issues which can be harmful to the users. If the illuminance level is low, it will lead to seasonal affective disorder.

This study shows how illuminance level affects the student's concentration in the class. A learning environment with a decent quality of light is essential to the users because this will influence the knowledge receiving process and concentration span. Students are required to read on different surfaces, namely the writing on their notes or the screen projector in front of the class and they must always adjust their gaze [19]. This research is also important to make some improvements to the lighting system in the learning environment, natural lighting is always considered the best source of lights due to its positive effects on the users. This paper concludes by suggesting the university consider natural lighting whenever it is possible to mitigate the health issues caused by over illuminance.

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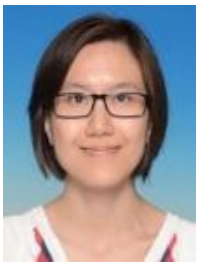

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