# Study on the Effects of Learning by Changing the Color-Temperature LED Lamp

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#### Abstract

This paper was used as a classroom ceiling, fluorescent lighting currently installed using LED light sensitivity. The mood of the music room and art room created by the room color and lighting can improve a learner's creativity. Approximately 3,000K color-temperature lighting can affect various senses of a student. A psychological assessment of students was carried out under classroom illumination using Relux software. LED replaced the fluorescent lighting in the classroom. As a result, learning increased by approximately 25% with the LED lamps than with fluorescent lamps. In addition, the average illuminance was derived from the illumination law.

Keywords: LED, Color-temperature, Emotional-lighting, Relux

### **1. Introduction**

The main purpose of lighting is to provide comfortable vision, efficiently. The appropriate lighting environment improves business skills and vision characteristics. Increased awareness of energy conservation worldwide has demanded advanced energy sources. The LED (Lighting Emitting Diode), a light source using a semiconductor, has developed into a new lighting technology of much interest [1, 2]. LED lighting systems have advantages over conventional light sources, they have high efficiency and low power-mad can be made into various shapes to provide a wide range of luminous intensities, and provide emotional illumination and illuminant color changes, such as high color rendering. Thus, LED lighting technology has been applied for general lighting, displays and in automotive, medical, and agriculture fields. As optics, heat, circuits, systems and design. In addition, recent developments have been on creating a pleasant lighting environment for the occupant of that environment. At first, the psychological aspects of lighting comfort was rated subjectively; since then, they have been rated objectively to assess physiological changes in the occupant [3, 4]. This paper investigates the effect of LED lighting installed in a classroom on student psychology. The mood of the music room and art room created by the room color and lighting can improve a student's creativity. Approximately 3,000K color-temperature lighting can affect various senses psychological assessment of students were carried out in a classroom where the fluorescent lighting had been replaced by LED lightning using Reflux software.

# 2. Theory

#### **2.1. Experimental Procedure**

A simulation program was Relux. A school classroom was simulated. 42W LED lamp  $\times$  8 (FL Type) was purchased. Simulation conditions are provided in Table 1.

Plac	e	Classroom						
Size		$7.5m \times 9m \times 2.5m$						
Reflectivity	Ceiling	0.9						
	Walls	0.85						
	Floor	0.85						
Lamp		LED(0.2W x 192EA), 42W						
Luminair	es Size	600 x 600mm						
Light Distribution Curve		Lamp Type: Lambertian						

### Table 1. Simulation Conditions



Figure 1. Layout Drawings of Classrooms and Fixtures

Figure 1 is a representation of the classroom and lighting equipment layout used in the simulation. LED ( $0.2W \times 192$  EA), Color-temperature 3,000K, 42W luminaires were placed in a 600 × 600mm LED module. Landscape lighting design consisted of four columns and two rows of lighting.

### 2.2 Experimental Analysis



Figure 2 shows the simulation results of LED lamp light distribution in 3D View. Figure

(a) and (b) are the results of the LED lamp light distribution on a 3D floor plan.



Figure 3. 42W LED Lamp × 8 (FL Type) Calculation Results

[m]	(342)	355	366	373	379	384	388	3 <u>9</u> 0	3 <u>9</u> 2	391	392	393	391	389	385	380	374	367	356	(342)
6.5 -	370	389	404	412	418	423	429	4 <u>3</u> 2	433	431	432	434	434	4 <u>3</u> 0	424	419	414	405	391	372
6.0 -	411	438	459	467	470	476	486	492	490	486	486	491	494	488	4 <u>7</u> 8	472	469	461	441	414
5.5 -	451	491	519	526	525	531	548	557	552	541	542	553	559	550	534	5 <u>2</u> 8	529	522	495	455
5.0 -	479	527	560	566	561	568	588	6 <u>0</u> 1	5 <u>9</u> 3	579	579	594	[6 <u>0</u> 3]	5 <u>90</u>	571	564	5 <u>69</u>	564	531	484
45	484	528	559	567	566	573	591	601	595	5 <u>8</u> 3	584	596	[6 <u>0</u> 3]	5 <u>9</u> 3	575	569	571	564	533	488
	475	511	537	548	550	559	571	579	575	569	569	577	581	573	5 <u>6</u> 2	554	5 <u>5</u> 2	542	516	480
4.0 -	469	501	525	537	542	549	560	566	564	560	560	566	568	563	552	546	541	530	506	474
3.5 -	476	511	538	548	550	558	570	579	575	569	569	577	581	573	562	554	552	542	516	480
3.0 -	484	529	560	567	566	572	590	ஹ	594	583	583	596	[6 <u>0</u> 3]	594	576	570	571	564	533	489
2.5 -	481	528	560	566	561	568	588	<u>60</u> 0	592	579	579	595	[6 <u>0</u> 3]	5 <u>91</u>	572	565	570	565	533	485
2.0 -	454	493	520	527	526	532	5 <u>4</u> 8	557	552	542	542	554	550	552	536	530	531	525	497	458
1.5 -	415	442	462	4 <u>6</u> 9	472	478	498	494	4 <u>9</u> 2	487	488	494	497	491	481	476	473	465	445	418
10	376	394	408	416	421	427	4 <u>3</u> 3	4 <u>3</u> 6	4 <u>3</u> 7	4 <u>3</u> 5	4 <u>3</u> 6	4 <u>3</u> 9	4 <u>3</u> 9	4 <u>3</u> 6	4 <u>3</u> 0	425	4 <u>1</u> 9	412	397	378
1.0 1	348	361	372	379	385	390	394	396	3 <u>9</u> 8	398	398	399	398	396	392	388	382	375	363	350
	1 2 3					4 5				6			7			8 [m]				
	Illuminance [Ix]										[]									
Height of the reference plane Average illuminance Minimum illuminance Maximum illuminance Uniformity g1 Uniformity g2						Eav Emin Emax Emin Emin	( /Eav /Emax		0.75 n 499 lx 342 lx 503 lx 1 : 1.4 1 : 1.7	n 16 (0.68 17 (0.57	3) 7)									

Figure 4. 42W LED Lamp × 8 (FL Type) Illuminance Distribution

Figure 3 and Figure 4 shows the simulation results of the intensity distribution in the classroom installed with LED lamps. 42W LED lamp  $\times$  8 (FL Type) 4,650lm was installed eight of LED lamp when the result value is the full beam was measured speed of light 37,200lm, power 336W, average roughness of the 499lx, and a minimum illumination 342lx, the maximum roughness 603lx.unclear Illumination of the desk was manned by part 540 ~ 600lx If you compare the distribution of the illumination the LED lamp. In addition, the intensity distribution of outer shell was 400lx or less.

Space	Illumination Classification	Illumination (lx)
Classroom	G	300- <u>400</u> -600

The simulation results were based on the Illuminance of the Korea Industrial Standard (KSA-3011), as shown in Table 2 for fit.

### 2.3. Apply Emotional-lighting Surveys



(a) General Fluorescent (2/40W FL)



(b) LED Lamp (42W LED)

**Figure 5. Lighting Installation Pictures** 

Figure 5 is a fixture in the classroom simulation Spec. and placed in the same general fluorescent lamps and LED lamp photos.

 $\ensuremath{\mathfrak{K}}$  Please check the appropriate box  $\lor.$ 

Survey (Fluorescent)	5	4	3	2	1
	Very	A Little	L las salls s	Slightly	Very
1. What do you think the brightness of the classroom?	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
	Very	A Little	Lieveller	Slightly	Very
2. Psychological stability of light do you think?	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
2 Elucroppont lights in the learning onvironment did	Very	A Little	Lloughy	Slightly	Very
5. Floblescent lights in the learning environment did	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
become less enective:					
4. Eluproport loss officitive in the losming poods did	Very	A Little	Housily	Slightly	Very
4. Fluorescent less enective in the learning needs did	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
nave:					
5 Euprescent lighting is less effective in learning	Very	A Little	Llouelly	Slightly	Very
outcomes happened?	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
outcomes happened?					
6. Fluorescent in this study, please describe the					
advantages and disadvantages.					
Total Points					

st Please check the appropriate box  $\lor$ .

Survey (Fluorescent)	5	4	3	2	1
	Very	A Little	Llough	Slightly	Very
1. What do you think the brightness of the classroom?	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
				2 Slightly Dissatisfied Slightly Dissatisfied Slightly Dissatisfied Slightly Dissatisfied Slightly Dissatisfied	
	Very	A Little	Lloughy	Slightly	Very
2. Psychological stability of light do you think?	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
2 Elucroport lights in the learning onvironment did	Very	A Little	Lloughy	Slightly	Very
become loop offective?	Satisfied	Satisfaction	Ostany	Dissatisfied	Dissatisfied
4. Elucroscont loss offective in the learning people did	Very	A Little	Lloughy	Slightly	Very
4. Publiciscent less enective in the learning needs did	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
nave:				Slightly Dissatisfied Slightly Dissatisfied Slightly Dissatisfied Slightly Dissatisfied Slightly Dissatisfied	
5 Euprescent lighting is less effective in learning	Very	A Little	Lloually	Slightly	Very
outcomes happened?	Satisfied	Satisfaction	Usually	Dissatisfied	Dissatisfied
6. Fluorescent in this study, please describe the					
advantages and disadvantages.					
Total Points					

Figure 6. Survey Form

Figure 6 is an emotional and learning assessment questionnaire for the lighting installed. Survey results are as follows LED brightness was more satisfactory than fluorescent brightness. (25% Increase); fluorescent light from the LED provided more psychological stability. (30% Increase); LED lamps provided a more positive learning environment (25% Increase); learning improved with LED lamps than with fluorescent lamps (25% Increase); and more positive feeling resulted from LED lamps than from fluorescent lamps (25% Increase).

### **3.** Conclusion

This paper investigated the effect of LED lighting in the classroom on student psychology. The mood of the music room and art room created by room color and lighting can improve student creativity. Approximately 3,000K color-temperature lighting can affect various senses of a student. Psychological assessment of students was carried out under classroom illumination where fluorescent lighting was replaced by LED using Relux software. Eight LED lamps of 42W LED lamp× 8 (FL Type) 4,650lm were installed, they provided speed of light 37,200lm, power 336W, average roughness of the 499lx, minimum illumination 342lx, and maximum roughness 6031x. Illumination of the desk was manned by part 540 ~ 6001x If you compare the distribution of the illumination the LED lamp. In addition, the intensity distribution of the outer shell in the classroom was 400lx or less. The simulation results, which were based on the Illuminance of Korea Industrial Standard (KSA-3011), were as follows, students were more satisfied with LED brightness than with fluorescent brightness (25% Increase), fluorescent light from the LED provided more psychological stability (30% Increase), LED fluorescence created a more positive learning environment (25% Increase), learning improved with LED lamps than with fluorescent lamps (25% Increase), and LED lamps created more a positive feeling than fluorescent lamps. (25% Increase)

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