The Changing Lighting of Classroom for the Different Learners' Background

Preechaya Krukaset, Suan Sunandha Rajabhat University, Thailand

The Asian Conference on Cultural Studies 2018
Official Conference Proceedings

Abstract
The purpose of this research is to study and compare different lighting design factors affect learners' learning behaviours. The research hypothesis is that different lighting design factors affect learners' learning efficiency within classrooms. They enhance the ability to learn and support or promote learners' learning and stimulate the interest of the students. The research method was exploratory and interviews of learner's popularity with the use of lighting in the classroom. The research instruments used were interviewing form and classroom physical environment modelling by different lighting issues. Through controlling other design factors (an unadorned environment) to reduce the attention of interview respondents and no stimulated of their feeling. The questionnaires were used to collect two issues. There are the personal data of 50 non-artistic learners or designers and 50 artistic learners or designers, totalling 100 people, and the data of the correlation of perception between the two groups' and response of learner groups; friendly, relieve, privacy, excitement, niceness of classroom and overall satisfaction. These all reaction to classroom environment with different lighting in 3 main factors; light pattern, colour temperature and type of light. The results found that the diffuse-lighting is more suited to classroom design than the point-lighting.

Keywords: learners' background, Perception, learning style, lighting factor

Introduction

The classroom and work environment of school or university is changing more rapidly. Technological innovation is empowering educational organisations and individuals to explore new improved ways of design to develop and improve that place. Cause the users of workplaces of the classroom are essential. The designer is therefore obliged to accept the challenge to deal with all aspects to achieve optimum efficiency and minimise physical and mental stress and strain on users. The lighting factor is also an important issue in designing the environment. Especially the factors of light conditions that affect the behaviour both regarding uniform brightness and light pattern. The designer has to think the efficient use of light energy, and lighting technology varies by area or area of use, the temperature of the light and the colour of light. Therefore, proper lighting design there is a difference in the physical requirements such as work or study, where lighting has a significant effect on the behaviour of the user. This concept is a significant challenge for architects and designers to take into account during the physical design process to enhance the efficiency of work.

The extensive research upon which this paper-based, concentrated on classroom environment with different lighting in 3 main factors; light pattern, colour temperature and type of light that contribute towards the perception and response of learner groups. The main theme of the research emerged from interior design and lighting design, while the research questions and research variables stem from interrelated disciplines such as work psychology, social psychology of work, behaviour and environment. The research designed in stages with varied methodological options and the data of a survey with a random sample of 100 classroom users using a visual questionnaire. The results were analysed using SPSS (Statistical Package for Social Sciences). This paper only reflects the data analysis pertinent to different lighting, as expressed by classroom users, are non-artistic learners or designers and artistic learners or designers, which would offer guidelines for interior designers and facilities managers.

Literature background

Lighting technologies differ along multiple dimensions such as light pattern, colour temperature and type of light. Lighting can also vary based on physical specifications such as functionality, and ease of use. Lighting serves the fundamental aim of supporting the human vision, and different factors, for example, light pattern and colour temperature have been shown to affect operator perception, cognition and mood state. Though there has been considerable research into the lighting, relatively research has considered how the lighting might affect human performance. Humans work in lighted environments on a daily basis, and many environmental factors combine to affect them both physiologically and psychologically. The importance of lighting for the human vision, indeed it is difficult to imagine performing many daily tasks without sufficient lighting. A recent survey of the existing research influences on human performance revealed that the majority of the lighting literature examines effects on human physiology. That review found many studies on lighting effects on circadian rhythm, with discovery such as insufficient light exposure causes sleep fragmentation. Also, there is research showing that exposure to full spectrum lighting can improve seasonal affective disorder, a disorder can cause depression-like

symptoms during months of less sunlight. Considering these effects of lighting on human physiology, increasing studies have examined how varied lighting conditions might further alter more psychological processes, such as mood, memory, and processing speed.

Mood, or emotional state, can generally be divided into two bipolar and theoretically orthogonal constructs: valence and arousal. Valence describes the negative (e.g., sadness) to positive (e.g., happiness) dimension, and arousal describes the high (e.g., excitement) to low (e.g., sleepiness) arousal dimension. Some have shown that people are positively appreciative of enhanced lighting settings, though only a handful of recent studies have demonstrated effects of lighting colour temperature on participant mood states. Colour temperature typically described in units of absolute temperature. In general, higher colour temperatures are bluish white and typically referred to as cooler colours, whereas lower colour temperature is yellowish red and typically referred to as warmer colours. Knez and Kers (2000) demonstrated that younger adults preserve negative mood in warm relative to cool fluorescent lighting while working on cognitive tasks. Mills et al. (2007) presented that very high colour temperature workplace lighting could enhance worker alertness, reduce worker exhaustion, and increase work productivity similar to Hoffmann et al. (2008) found enhanced levels of activity/arousal and concentration.

More experimental designs with multiple and carefully controlled lighting parameters and highly sensitive cognitive tasks might show different results. There is a reason to believe that under such carefully-controlled conditions, lighting can alter environmental conditions enough to increase positive mood, decrease exhaustion, and improve cognitive performance. In point of fact, there is theoretical support in experimental social psychology to support the notion that positive moods can benefit memory and other cognitive tasks such as problem-solving. In the cognitive research demonstrates that negative low arousal states can slow task performance, and there is some evidence that low colour temperatures might promote fatigue and negative mood states (Breanne et al., 2012).

The purpose of this research is to study and compare different lighting design factors affect learners' learning behaviours. We hypothesize that different lighting design factors affect learners' learning efficiency within classrooms. They enhance the ability to learn and support or promote learners' learning and stimulate the interest of the students.

Method

1. Subjects

In this research method was exploratory and interviews of the classroom user's popularity. The research instruments used were interviewing form and classroom physical environment modelling by different lighting issues. Through controlling other design factors (an unadorned environment) to reduce the attention of interview respondents and no stimulated of their feeling. The questionnaires were used to collect two issues. There are the personal data of 50 non-artistic learners or designers and 50 artistic learners or designers, totalling 100 people, and the data of the

correlation of perception between the two groups' and response of learner groups; friendly, relax, privacy, excitement, niceness of classroom and overall satisfaction.

Figure 1: Example of Stimuli (3D) (an unadorned environment) as Tool

2. Experimental Tool

The research tool divided into 2: interview forms design and modelling the physical environment in different lighting issues. Interview design, in this section, we set the questions to be divided into two groups; artistic education group and no-artistic education group to find the relationship between the two groups' awareness levels and the sensory response to the physical environment of the light. The indicators for evaluating the design approach of light selection in the classroom are three types of light; light pattern, colour temperature and type of light. The interview forms constructed as a comparison between the left image and the right image to compare attitudes and satisfaction of the classroom users. By experimenting with Stimuli (3D) in a related classroom environment with different lighting. By each side has five levels of popularity.

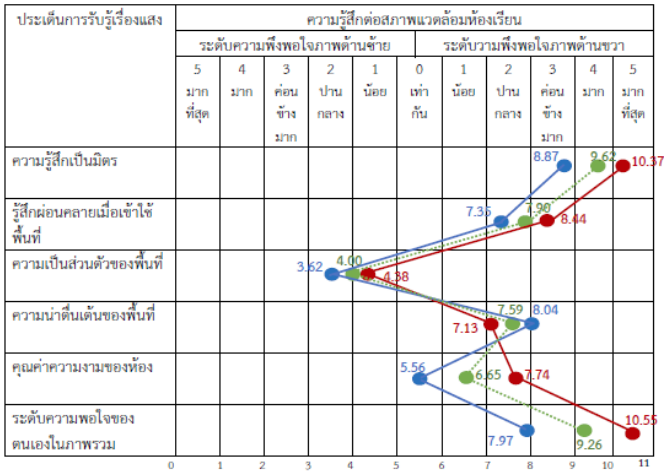

Figure 2: Interview forms constructed as a comparison between the left and right image

3. Lighting factors

In this part, we choose classroom environment with different lighting in 3 main factors; light pattern, colour temperature and type of light. The subjects are as follows.

- Light pattern:
    - Spot-lighting (*S*) and Diffuse-lighting (*D*)
- Colour temperature:
    - Warm lighting (*WL*) and Daylighting (*DL*);
    - Spot-Warm lighting (*SWL*) and Diffuse-Warm lighting (*DWL*);
    - Spot-Daylighting (*SDL*) and Diffuse-Daylighting (*DDL*);
    - Spot-Warm lighting and Daylighting (*SWDL*) and Diffuse-Warm lighting and Daylighting (*DWDL*)
- Type of light:
    - Artificial lighting (*A*) and Natural lighting (*N*);
    - Mix Natural-Diffuse-Warm lighting (*MixNDWL*) and Mix Natural-Diffuse-Daylighting (*MixNDDL*);
    - Mix Natural-Spot-Warm lighting (*MixNSWL*) and Mix Natural-Spot-Daylighting (*MixNSDL*);
    - Mix Natural-Spot-Warm and Daylighting (*MixNSWDL*) and Mix Natural-Diffuse-Warm lighting and Daylighting (*MixNDWDL*)

The results and conclusion

The results of the analysis of the data divided into two groups. The first group, 50 of 100 people are an artistic group who are the art students of the undergraduate level as the representative of the group. Another group is a non-artistic group who is the student of the undergraduate level without art or design background. We assigned this sample to be the undergraduate student in other subjects. All participant are an average age of 20 years. There are 45 residents of Bangkok and 55 residents of other provinces, respectively, with an average income of 5,225 Thai Baht. The results of the popularity level analysis are detailing below.

1. Light pattern

1.1 Comparison of Spot-lighting (S) and Diffuse-lighting (D)
Overall satisfaction of both groups is *D*. There is a trend in the popularity of light patterns in almost the same feeling of both groups. The only subject is excitement that both groups have a different feeling. Artistic group think the *S* light patterns that are exciting whereas non-artistic group think that *D* light patterns are exciting.

Figure 3: Comparison of Spot-lighting (S) and Diffuse-lighting (D)

2. Colour temperature

2.1 Comparison of Warm lighting (WL) and Daylighting (DL)

The popularity of colour temperature of both groups is almost the same feeling. The only subject is niceness of classroom that both groups have a different feeling. Artistic group think the *DL* that are niceness whereas non-artistic group think that *DL* and *WL* are the same feelings. Howsoever, overall satisfaction of both groups is DL.

Figure 4: Comparison of Warm lighting (WL) and Daylighting (DL)

2.2 Comparison of Spot-Warm lighting (SWL) and Diffuse-Warm lighting (DWL)
The popularity of colour temperature of both groups is the same feeling. Both groups favor *DWL* in the subject as friendly, relax and niceness of classroom.

Figure 5: Comparison of Spot-Warm lighting (SWL) and Diffuse-Warm lighting (DWL)

2.3 Comparison of Spot-Daylighting (SDL) and Diffuse-Daylighting (DDL)
Overall satisfaction of both groups is *DDL*. The popularity of colour temperature of both groups is almost the same feeling. The only subject is niceness of classroom that both groups have a different feeling. Artistic group think the *SDL* that is niceness whereas non-artistic group think that *DDL* and *SDL* are the same feelings.

Figure 6: Comparison of Spot-Daylighting (SDL) and Diffuse-Daylighting (DDL)

2.4 Comparison of Spot-Warm lighting and Daylighting (SWDL) and Diffuse-Warm lighting and Daylighting (DWDL)

The popularity of colour temperature of both groups is different in all subjects. Artistic group favour *DWDL* in all subject, on the other hand, non-artistic group favour *SWDL* and *DWDL*. Overall satisfaction of both groups is DWDL.

Figure 7: Comparison of Spot-Warm lighting and Daylighting (SWDL) and Diffuse-Warm lighting and Daylighting (DWDL)

3. Type of light

3.1 Comparison of Artificial lighting (A) and Natural lighting (N)

However, when we compared the Artificial lighting and Natural lighting, we found the difference. Both groups favour *N* more than *A*. The popularity of the type of light of both groups is the same feeling in all subjects. Both groups favor N in the subject as friendly, relax, privacy, excitement and niceness of classroom.

Figure 8: Comparison of Artificial lighting (A) and Natural lighting (N)

3.2 Comparison of Mix Natural-Diffuse-Warm lighting (MixNDWL) and Mix Natural-Diffuse-Daylighting (MixNDDL)

The popularity of the type of light of both groups is the same feeling in all subjects. Both groups favour *MixNDDL* in three subjects as friendly, relax, and niceness of classroom. In the privacy, both groups favour *MixNDDL* and *MixNDWL* as same. However, both groups favour *MixNDWL* in the excitement subject.

Figure 9: Comparison of Mix Natural-Diffuse-Warm lighting (MixNDWL) and Mix Natural-Diffuse-Daylighting (MixNDDL)

3.3 Comparison of Mix Natural-Spot-Warm lighting (MixNSWL) and Mix Natural-Spot-Daylighting (MixNSDL)

Overall satisfaction of both groups is *MixNSDL* and *MixNSWL* as same in almost subject. Nevertheless, there is only subject that both groups have a different that Artistic group think *MixNSDL* that relax whereas non-artistic group think that *MixNSWL* is relaxed in three subjects as privacy, excitement, and niceness of classroom.

Figure 10: Mix Natural-Spot-Warm lighting (MixNSWL) and Mix Natural-Spot-Daylighting (MixNSDL)

3.4 Comparison of Mix Natural-Spot-Warm and Daylighting (MixNSWDL) and Mix Natural-Diffuse-Warm lighting and Daylighting (MixNDWDL)

The popularity of the type of light of both groups is different in all subjects. Artistic group favour *MixNDWDL* in all subject, on the other hand, non-artistic group favour *MixNSWDL* in all subject.

Figure 11: Mix Natural-Spot-Warm lighting (MixNSWL) and Mix Natural-Spot-Daylighting (MixNSDL)

In conclusion, the results found that Diffuse-lighting is more suited to classroom design than Spot-lighting. Colour temperature of the light found that Daylighting can

feel relax and excite when the learner is using area, and also promote niceness of the classroom. In the classroom design, if the designer uses Warm lighting, it will respond to the privacy rather than Daylighting. Diffuse-Daylighting is more appropriate for classroom design than Spot-Daylighting. Wherewith can respond to the needs of the learner, contribute to the ability to learn, support or promote learners' learning and stimulate the interest of the learner. Due to Diffuse-Daylighting build the sentiment as friendly and relax when the learners use the classroom. However, if the designer wants to design a classroom that emphasises privacy, exciting and enriching the niceness, they should choose Spot-Daylighting.

Figure 12: Diffuse-lighting as Overall satisfaction for classroom design

Suggestion and future research

This research has been carried out according to the research process to answer the research hypothesis for a limited time. However, if this results of the study used, there must be a similar context. Also, should have an in-depth study of other factors such as learning objectives and learning activities. Including research tools should also be developed like the environment mockup model, if there is capital. These factors may analyse the more rational relationship that will lead to further development of knowledge. The essence of designers should take into account in their design namely the different of characteristics between area user groups and specific features of the user. So designers should focus on the sense of place as though the necessary theory. It can be beneficial to the design and develop the design research possible. All these are the suggestion for future research.

Acknowledgement

My sincere thanks go to my research grants, Suan Sunandha Rajabhat University, for the support of my study and related research.

References

Breanne, K. H., Tad, T. B., Caroline, R. M., John, M. S., Christian, D. A., (2012). Effects of four workplace lighting technologies on perception, cognition and affective state. *International Journal of Industrial Ergonomics 42 (2012) pp. 122-128.*

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Hoffmann, G., Gufler, V., Griesmacher, A., Bartenbach, C., Canazei, M., Staggl, S., Schobersberger, W., (2008). Effects of variable lighting intensities and colour temperatures on sulphatoxymelatonin and subjective mood in an experimental office workplace. *Applied Ergonomics 39, pp.719-728*.

Ittelson, W. H., Pronshansky, H. M., Rivlin, L. G. and Winkel, G. H. (1974). *An Introduction to Environmental Psychology*. New York: Holt, Rinehart and Winston.
Knez, I., Kers, C., (2000). Effects of indoor lighting, gender, and age on mood and cognitive performance. *Environment and Behavior 32, pp.817-831*.

Lang, Jon. (1974). Thories of Perception and "Formal" Design. In Lang, Jon (Ed.) *Designing of Human Behavior*. Pennsylvania: Hutchinson and Ross Inc.

Mills, P.R., Tomkins, S.C., Schlangen, L.J.M., (2007). The effect of high correlated colour temperature office lighting on employee well-being and work performance. *Journal of Circadian Rhythms 5, pp. 2*.

Nomana, A., Jeanette, P., Roland, A., (2004). The changing environment of offices; a challenge for furniture design. *Design Studies Volume 26 No. 1, pp. 73-74.*
Randall Fielding. (2006). *Leaning, Lighting, and Color*. Retrieved June 26, 2016 from www.DesignShare.com.

Preechaya, Kr., (2018). Floorplan-analysis, lighting and physical environment of classroom design. *The 2018 International Academic Research Conference in Vienna, pp.88-89.*

Preechaya, Kr., (2010). The Physical Environment Affects Human Perception of Environmental Consciousness Concept. *The International Journal of Environmental, Cultural, Economic and Social Sustainability, Volume 6, Issue 6, pp.193-202*.

Contact email: preechaya_4@hotmail.com