

# An Empirical Study on Ambient Conditions and Learning Effectiveness of State Universities in Sri Lanka: A Case Study in Selected Faculties of the University of Sri Jayewardenepura

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## Abstract

This study examined the relationship between the ambient conditions and the learning effectiveness of undergraduates at state universities in Sri Lanka based on a case study conducted at University of Sri Jayewardenepura. The general objective of this research is to identify the relationship between ambient conditions in the physical environment to enhance the learning effectiveness of state university undergraduates. Ambient conditions: temperature, Lighting, Seat Arrangements, Ambient Intelligence, and Color were the independent variables of the research whereas Learning effectiveness was the dependent variable. A hundred undergraduates from two faculties of the university were selected through a random sampling method and collected data through a structured questionnaire. Both quantitative and qualitative approaches were utilized in the analysis. The correlation analysis has been employed to identify the relationship between ambient conditions and learning effectiveness. Ten hypotheses were tested using the Pearson correlation test and all the hypotheses were rejected. Further, the study employed another four tests named Mean analysis, Demographic profile, Existing facilities, and Ambient preferences. As per the findings of the study all the tested ambient conditions create a positive relationship with the learning effectiveness of the undergraduates in both faculties. However, due to the multiple regression results, only the Temperature and Lighting create an impact on learning effectiveness. Most of the architects and educational administrators were faced with difficulties in creating comfortable environments to develop learning effectiveness. Therefore, these findings can suggest the best solutions for a better learning environment. Moreover, developers can add some features to the learning environment based on student's feedback.

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*Keywords: Learning Effectiveness, Undergraduates, Education, Ambient Conditions*

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## Introduction

Education empowers the acquisition of new skills and knowledge that ultimately increases productivity. Higher education in Sri Lanka always involves constant change and it interacts with the physical environment. University students are considered the most important people in the future labor market because they are the people who lead the country in the future. Normally they absorb more knowledge, experiences, and new technologies from the university compared to other students. Advancement of the human capital is the first step for the development of the

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human resource. Hence, the administrators, educators, policymakers, and companies invest and allocate resources on human resources in the labor market and pay more attention to the performance of students in universities. It's noted that some students in Sri Lankan universities tend to give-up their degrees or are unsuccessful in examinations. Therefore, the learning effectiveness of undergraduates to be considered to identify the actual nature of the issue.

Learning effectiveness was affected by different factors such as self-motivation of the students, course level, classroom climate, and teaching methods. This study mainly focuses on the effect of classroom climate on students' performances. A supportive learning climate has become the most significant motivating factor for the development of human resources (Comer, Lenaghan & Sengupta 2015). This consists of various types of work environments that are likely to influence the learning of individuals, groups, and organizations. Nowadays classroom learning is identified as key to developing the types of knowledge and skills and it's more important to run the labor market effectively.

Determinants of students' learning effectiveness have become an important research theme for researchers. This study was conducted to identify the relationship between selected ambient conditions: Temperature, Lighting, Ambient Intelligence, Color, and Seat Arrangements with learning effectiveness. The general objective of this research is to identify the relationship between ambient conditions in the physical environment to enhance the learning effectiveness of state university undergraduates. This study has observed on the ambient conditions in the learning environment and analyzed the existing facilities and future improvements from the student's perspective. Further, it has emphasized the impact of Ambient Conditions on the learning Effectiveness of the student. The finding highlights the importance of ambient conditions for the learning effectiveness of university students. Hence, the results suggest that the management of universities, architects, and developers should consider ambient conditions to enhance the learning effectiveness of universities.

### **Objective of the Study**

This research mainly focuses on identifying the relationship between ambient conditions in the physical environment to enhance the learning effectiveness of state university undergraduates focused on two faculties.

### **Literature Review**

#### ***Learning Effectiveness***

The three main methods for acquiring human resources are experience, training, and education. Among them, education is the most important factor to develop students. Education allows the acquisition of new skills and knowledge that finally increases productivity. An increase in the productivity of learners delivers up resources to create new technologies, new businesses, and new wealth. The term education was defined by many educationists, philosophers, and authors. Among them great philosopher Aristotle said, "Education is the process of training man to fulfil his aim by exercising all the faculties to the fullest extent as a member of society". Educational achievements can be measured using various ways such as studies related to primary education, writing and solving mathematical tests, etc.

In higher education, academic achievements are considered the learning outcomes and they can be calculated in terms of both individual and group levels. The term "effective learning" is widely used and it represents the idea that all studies in their best. In the 3P model of student learning, Exam results, self-concept, satisfaction, and grade point average are considered as measurements of the learning effectiveness of university students (Biggs et al.,2001). As per Comer, Lenaghan

& Sengupta (2015), learning effect is affected by three factors learning characteristics, teacher's characteristics, and classroom context.

Krčmarská et al. (2014) mentioned important characteristics and collections of abilities that enable a person to act in advance in a job market after graduation. In other words, it is discussed the factors act as a supplementary part of academic success. Aitken (1982), introduced some factors based on learning effectiveness as the physical environment used to do academic work, teachers and university peers, and personal characteristics like inner motivation to study, attitudes, characteristics and temper, abilities, and skills. Schools promote learning effectiveness to establish motivation, social relationships for learning, and overall learning culture. Sometimes these intellectual thinking activities are used to process the learning combined with classroom management. Teacher learning outcomes also improved due to the physical environment and skills of classroom management influence students learning achievements by converting the learning process. Hence, the above findings identified climate of the institution directly affected the learning effectiveness. Environmental psychologists are believed that physical factors are creating an impact on human's daily thoughts and behaviors. Learning effectiveness plays an essential role in producing valuable graduates. The highest quality graduates are essential because they will become future dominant leaders and manpower for the country. Not only that they are responsible persons for the country's economic and social development. Hence, the administrators, educators, policymakers, and companies invest and allocate money on human resources in the labor market and pay more attention to the performance of students in universities. Employers consider academic performance as one of the key qualifications in recruiting employees. Therefore, Academic results and learning effectiveness play a great role to fulfil the employer's requirements.

### ***Ambient Features***

Most of the scholars discussed the aspects such as ambient conditions and layouts which are particularly affected by behavior and the productivity of the employees (Anitha 2014; Duque et al. 2020; Kamaruzzaman & Zawawi 2011; O'Donnell, Ruth-Sahd & Mayfield 2019; Vienna 2017). Characteristics which are in the environment like ventilation, temperature, lighting, color, and view are commonly considered ambient conditions (Bitner 1992). When designing a supporting better place for the organization must consider the design factors, "Naturalness"- (Light, Temperature, Air quality)," Individualization"- (Personal control over the spaces), "Stimulation" (color, complexity) (Jacoby 2017). These ambient factors influence satisfaction and the felling way of the individuals with the experience of the environment and task performance. Sundstrom & Sundstorm (1986) under the purpose of a comforting environment above features are the indicators of user's satisfaction in an environment, Health, and efficiency in the living spaces. Therefore, it is very essential to identify the ambient conditions of the organizations individually. The simple meaning of the ambient features related to the immediate surroundings of the universities is as follows.

### ***Temperature***

Ambient temperature is the air temperature at which any objects or environmental equipment are kept. When designing an effective learning environment temperature is a prominent factor and it plays a significant role in creating a comfortable environment behalf of performing a task. Possibly the perfect temperature must not be too cool or hot. This factor directly affected the academic effectiveness of the students (Earthman 2002). Accordingly ideal temperature must be between 68 and 74°F—20 and 24°C to conduct the lessons comfortably. The ideal temperature must be changed with the environmental temperature, but this directly impacts student's performances.

### ***Lighting***

The quality and the quantity characteristics of light affect the comfort of the people in the organization. The study which is carried out by Boray, Gifford & Rosenblood (1989) assess how various type of lightning affect the variables like intellectual performance, room attractiveness, size of room, and comfort of the room. According to the empirical findings of this study, management prefers warm white or cool white lightning because these are low cost and easy to maintain.

### ***Seat Arrangement***

Seat arrangement is another important ambient factor regarding the effective learning environment. This factor explains the operation of physical characteristics in the classroom to ensure the learning effectiveness of both students and teachers. Douglas & Gifford (2001), explains that seat arrangements in the classrooms may impact people comfortable in the learning environment and create a combination with the student's performances. Rosenfield, Lambert & Black (1985), further explained how the desk and chair arrangements impact the behavior of the students. According to the findings of the study students seated in a circle showed the most on-task behavior while desks and chairs in row arrangements showed the least effective.

### ***Ambient Intelligent***

Ambient intelligence is another factor used to achieve by mixing sensors, cameras, microphones, and other devices which can generate indicators based on the changes in the environment and the smart software system.

### ***Color***

Color is another factor that affected the learning effectiveness of people, and Color mainly effect maintaining student health and memory. Gilliam & Unruh (1988) examined the people's reactions and experiences using ordinary white walls and baker miller pink walls. Elliot exposed the sample to the selected three colors Black, Red, and Green, and check which color is mostly affected by the students' performance. Here get the results that most of the students are exposed to the red color. Therefore, the red color is used to present more important items. The colors might be responsible for specific student behavior. For example, red alert, increased pulse, activity; green balance, judgment, arrested movement, stability. Furthermore, they suggest the color green is best for classrooms. The mood of students and the workers is an essential part which directly connected with the performance.

### ***Impact of Ambient Conditions on Learning Effectiveness***

Learning space planning is the main cause of the success of higher education institutions (Harvey & Kenyon 2013). Then the new studies of the classroom are reflecting evidence about designed learning spaces producing helpful evidence, that designed learning environments are improving classroom participation and learning outcomes.

Satisfactory levels of the students may affect by ambient conditions and Layout, with optimal lighting, certain colors and proper Temperature have been found to contribute to the overall satisfaction of the school environment, High memory, and strong student interactions. Azemati, Aminifar & Pourbagher (2018) investigated the influence of physical variables on increasing productivity in learning environments. They found that four main physical factors: physical comfort, space layouts, physiological factors, and visual factors positively impact productivity in the learning environment. They further explained that there was a positive relationship between the physical dimension of architectural features and the productivity and productivity of users. The researchers emphasized that an efficient learning environment creates a positive

impact on the activities and learning of users. Xiong et al. (2018) examined the impacts of three physical environmental factors: temperature, noise, and illuminance on learning efficiency. They found that ambient temperature, noise, and illuminance had a significant main effect on learning efficiency. Some prior research on ambient conditions and research in open offices indicated that high levels of ambient conditions were associated with negative consequences such as interruption and weakened social support, and social interactions and this situation indirectly affects performance negatively.

## **Methods**

This research mainly focuses on identifying the relationship between learning effectiveness and the ambient condition of the facilities provided by the universities. Using literature temperature, Color, Ambient Intelligent, Seat Arrangements, and Lightning factors are considered as factors of ambient conditions. The University of Sri Jayewardenepura was select as a case study and the Faculty of Management Studies and Commerce and Faculty of Humanities and Social Sciences were considered for the study. The University of Sri Jayewardenepura is one of the largest universities in Sri Lanka. The target population of the study was the undergraduates of selected two faculties in the University. The Sample was taken through the Random Sampling method and consisted of 100 undergraduates from both faculties. The required data were mainly collected through a structured questionnaire. Other than that, interviews and observations were used to take feedback and ideas from the undergraduates. Data interpretation of this research was done from the student's point of view. The analysis focused on the quantitative approach and it uses both primary and secondary data.

Learning effectiveness is considered as the dependent variable of the study and learning effectiveness was calculated mainly based on GPA of the undergraduate students, lecture engagement, and dropout rates of the students considered for effectiveness calculation. The five independent variables were developed as Temperature, Color, Ambient Intelligent, Seat Arrangements, and Lightning based on literature. This research mainly used the Pearson correlation method to analyze data. The independent and dependent factors were measured using a five-point Likert scale that ranged from 1- 5 (strongly disagree to strongly agree). Availability of existing facilities and preferences were tested to identify ambient conditions in faculty and ambient conditions preferences of the students. Correlation analysis was done to identify the relationship between the ambient conditions and the Learning Effectiveness of the students. Furthermore, multiple regression analysis runs to find out the impact of the ambient conditions on the learning effectiveness of the students in both faculties. Mean analysis was done to rank the existing facilities based on the student's preferences and to compare social science and Management faculties based on existing facilities. In addition, ten null hypotheses were developed and tested using correlation analysis to check the relationship between ambient conditions and learning effectiveness in these faculties.

## **Results and Discussion**

Respondent's demographic profile was analyzed using four criteria: Gender, Extracurricular activity engagement, Happiness of the facilities, and GPA of the students. The sample obtained from the Faculty of Management Studies and Commerce consisted of an equal percentage of female students (50%) and male students (50%). Out of the respondents from the Faculty of Humanities and Social Sciences 46% were male while the rest were 54% female. This result implies that there was no significant difference in male and female participation in this research.

Extracurricular activities can enhance the learning effectiveness of undergraduates. Hence, University education pays special attention to these activities. Results show that in each faculty equal percentage of students engaged in extracurricular activities. This implies that a significant

proportion of total students in both faculties engage in extracurricular activities which may increase learning effectiveness.

The study further investigated the happiness of undergraduates towards the facilities available for both learning and extracurricular activities in the university. The data demonstrated that more than half of the respondents were not highly satisfied with the facilities for extracurricular activities and learning activities in the university. Compared to the students in the Faculty of Management Studies and Commerce, students in the Faculty of Humanities and Social Sciences were mostly dissatisfied with the facilities and ambient conditions available for learning.

Grade Average Point (GPA) of the students is categorized based on the classes. According to the data, the overall academic achievement level of the students of the Faculty of Management Studies and Commerce was greater than the students of the Faculty of Humanities and Social Sciences.

### ***Availability of Existing Facilities and Preferences***

The existing condition of the available facilities of the university was examined. Twenty items were selected based on previous literature and experiences and examined whether these facilities were available in those faculties. According to the data, students in both faculties indicated that they need more air conditions facilities, sanitary facilities, furniture comfort, enough space, curtains, laptop facilities, and photocopy facilities. The data also proved that the availability of facilities in the Faculty of Management Studies and Commerce Faculty was fairer than facilities in the faculty of Humanities and Social Sciences.

After analyzing the existing facilities, the study further observed the most preferred ambient condition criteria of the respondents (Table 01).

**Table 01: Criteria of Ambient Conditions (Both Faculties)**

<b>Ambient Factor</b>	<b>Criteria</b>	<b>Percentage %</b>
1.Lighting (lighting in the lecture halls)	Dim Light	0
	Bright Light	90
	Natural Light	10
2.Space between tables	Small space	0
	Medium Space	25
	Large Space	75
3.Color Schemes	Light	100
	Dark	0
4.Temperature	Cool	20
	Neutral	70
	Hot	10

*Source: Field survey (2020)*

Accordingly, the most preferred ambient conditions for a lecture hall were bright light, large space, light colors, and neutral temperature.

### ***Reliability and Validity***

Table 02 shows the reliability, validity, and mutual relationship of the selected data.

**Table 02: overall Reliability**

Faculty	Cronbach's Alpha	No of Items
Management	1. .816	2. 6
Humilities and Social Science	3. .807	4. 6

Source: Field survey (2020)

The overall value of Cronbach Alpha was higher than 0.7 (Table 05) and proved that the collected data was reliable and respondents answered accurately. As per the results obtained from KMO and Bartlett's Test value of the indicator in two faculties exceeded the level of 0.5 and confirmed the validity of the data set. Therefore, the results gained from the above two tests can be proved that the collected data sample was accurate.

**Table 03: KMO and Bartlett's Test**

Faculty	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	Sig
Humilities and Social Science	. 0.643	.000
Management	0.661	.000

Source: Field survey (2020)

### Factor Analysis (Correlation Matrix)

Correlation Matrix in factor Analysis was tested to understand the relationship between two variables and check whether all the variables were suited for the regression/correlation analysis (Tables 04 and 05).

**Table 04: Correlation Matrix- Faculty of Humilities and social science**

		Seat Arrangement	Color	Ambient Intelligent	Lightning	Temperature
Correlation	Seat Arrange	1.000	5. .396	6. .372	7. .446	8. .336
	Color	.396	9. 1.000	10. .747	11. .542	12. .301
	Ambient Intelligent	.372	13. .747	14. 1.000	15. .455	16. .293
	Lightning	.446	17. .542	18. .455	19. 1.000	20. .212
	Temperature	.336	21. .301	22. .293	23. .212	24. 1.000

Source: Field survey (2020)

**Table 05: Correlation Matrix-Faculty of Management**

		Seat Arrangement	Color	Ambient Intelligent	Lightning	Temperature
Correlation	Seat Arrange	1.000	.515	.424	.499	.339
	Color	.515	1.000	.191	.734	.189
	Ambient Intelligent	.424	.191	1.000	.159	.477
	Lightning	.499	.734	.159	1.000	.351
	Temperature	.339	.189	.477	.351	1.000

Source: Field survey (2020)

According to Tables 04 and 05, values of all the variables are less than 0.8. Hence, independent variables were free from the mutual interrelationships and suited for the regression analysis.

### Mean Analysis of Main Factors

**Table 06: Mean Analysis**

Faculty	Faculty of Humanities and Social Science		Faculty of Management	
	Mean	Rank	Mean	Rank
Seat Arrangements	3.5733	4	3.6000	4
Color	3.6767	2	3.6233	3
Ambient Intelligent	3.6533	3	3.6467	2
Lightning	3.6833	1	3.7367	1
Temperature	3.5680	5	3.5920	5

Source: Field survey (2020)

Table 06, summarizes the mean values of each variable that affect students' effectiveness in learning. The values demonstrate that the current condition of ambient conditions of the faculties was above the average. According to the ranking of mean values of existing lightning, was the most effective ambient condition in both faculties which satisfy the students more than the other ambient conditions. Compared to all five variables, temperature was the least satisfied ambient factor of both faculties. According to the above details students are highly satisfied with the existing lighting system and mostly suffered from uncomfortable temperature. Therefore, to increase the learning effectiveness the university should pay more attention to facilitate proper temperature conditions along with the other ambient factors.

### Pearson Correlation Analysis

Pearson Correlation Analysis was used to measure the strength of the association between independent and dependent variables. The data of this research was normally distributed and Pearson correlation analysis was conducted to examine the relationship between the selected ambient conditions and learning effectiveness of the students. SPSS correlation table was used to conduct the Pearson correlation analysis. The results of this analysis are summarized in Table 07.

**Table 07: Correlation analysis**

Factors	Correlation			Management faculty		
	Humilities and Social Science			Management faculty		
	Pearson Correlation	Sig.	N	Pearson Correlation	Sig.	N
Temperature	.667	.000	50	.690	.000	50
Lighting	.553	.000	50	.721	.000	50
Seat Arrangements	.382	.006	50	.317	.025	50
Ambient Intelligent	.293	.039	50	.298	.035	50
Color	.382	.006	50	.481	.000	50

Source: Field survey (2020)

The correlation values under both faculties indicate that there is a positive relationship between all five variables and learning effectiveness. Temperature and lighting in both faculties have a strong positive relationship (more than 0.5) with learning effectiveness. Color and seat arrangements have a moderate positive relationship whereas ambient intelligence has a weak positive relationship with the learning effectiveness of both faculties.



### ***Hypothesis Testing***

The null hypotheses were analyzed by using correlation analysis which tested the relationship between independent and dependent variables (Table 08). The null hypothesis in this research was rejected at a 5% level of significance (If sig. value is 0.05 or less than 0.05 the null hypothesis is rejected) (Table 08). The results indicate that all the ambient conditions Temperature, Lighting, Seat Arrangements, Ambient Intelligent, and Color create a relationship with the learning effectiveness of the students in both faculties. As per the Pearson correlation values, this relationship between all the ambient factors and the learning effectiveness of students is positive.

**Table 08: Hypothesis**

<b>Hypothesis</b>		<b>Null Hypothesis(H<sup>0</sup>)</b>
H <sup>1</sup>	Temperature creates a relationship with the learning effectiveness of the students in Humanities and Social Sciences Faculty.	Rejected
H <sup>2</sup>	Lighting creates a relationship with the learning effectiveness of the students in Humanities and Social Sciences Faculty.	Rejected
H <sup>3</sup>	Seat Arrangements creates a relationship with the learning effectiveness of the students in Humanities and Social Sciences Faculty.	Rejected
H <sup>4</sup>	Ambient Intelligent creates a relationship with the learning effectiveness of the students in Humanities and Social Sciences Faculty.	Rejected
H <sup>5</sup>	Color creates a relationship with the learning effectiveness of the students in Humanities and Social Sciences Faculty.	Rejected
H <sup>6</sup>	Temperature creates a relationship with the learning effectiveness of the students in the Management Studies and Commerce Faculty.	Rejected
H <sup>7</sup>	Lighting creates a relationship with the learning effectiveness of the students in the Management Studies and Commerce Faculty.	Rejected
H <sup>8</sup>	Seat Arrangements create a relationship with the learning effectiveness of the students in the Management Studies and Commerce Faculty.	Rejected
H <sup>9</sup>	Ambient Intelligent creates a relationship with the learning effectiveness of the students in the Management Studies and Commerce Faculty.	Rejected
H <sup>10</sup>	Color creates a relationship with the learning effectiveness of the students in the Management Studies and Commerce Faculty.	Rejected

### ***Regression Analysis***

Regression Analysis is normally done to describe how one variable is related to another variable. The study conducted multiple regression analyses to check the impact of ambient conditions on the learning effectiveness of the undergraduates.

**Table 09: Multiple Regression Coefficient**

<b>Factors</b>	<b>Sig. value Humanities and Social Science</b>	<b>Sig. value Management</b>
Temperature	0.000	0.002
Lighting	0.000	0.001
Seat Arrangements	0.235	0.051
Ambient Intelligent	0.591	0.724
Color	0.510	0.741

*Source: Field survey (2020)*

In Table 09, the sig value must be lower than 0.05 to statistically influence the dependent variable on the independent variables. According to the results of regression analysis, only the temperature and lighting show the sig value of less than 0.05. Thus, only a change in temperature and lighting can impact learning effectiveness in both faculties. However, the results of regression analysis do not create a conflict with the results of the correlation analysis because in

some circumstances it can be found that very strong correlation between variables but the change in one is completely independent of the change in the other variable.

## **Conclusion**

Environmental psychologists in the world believe that physical factors have been creating an unavoidable impact on human daily thoughts and behaviors. With that thought architects and other educational administrators always try to find out new strategies to increase the academic performances of the students. For that, they try out different teaching methods, smaller classrooms, different course levels, tutoring after the learning hours, etc. However, many researchers indicate that the physical environment and the ambient factors can influence the learning effectiveness of the students. This research was carried out to identify the relationship between ambient conditions and learning effectiveness inside the Faculty of Management Studies and Commerce and Faculty of Humanities and Social Sciences of the University of Sri Jayewardenepura.

This research mainly selected five ambient factors: Temperature, Lighting, Seat Arrangements, Ambient Intelligent, and Color based on the literature reviewed. As per the results, Faculty of Management Studies and Commerce had more modern facilities than the Faculty of Humanities and Social Sciences. Further, it was identified that students from both faculties expect more air conditions facilities, sanitary facilities, furniture comfort, enough space, curtains, facilities to use laptops and photocopy facilities, etc. According to the ranking of mean values existing lightning- condition was the most effective ambient condition in both faculties which satisfy the students whereas the temperature is the least satisfied ambient condition. However, all the ambient conditions of both faculties were above average. Further, it was found that all the ambient conditions created a positive relationship with learning effectiveness. Lighting and temperature build a strong positive relationship with learning effectiveness whereas ambient intelligence creates a weak positive relationship with learning effectiveness. The results from the multiple regression analysis revealed that temperature and lightning were the only ambient conditions that could create an impact on learning effectiveness.

The findings of this study help building constructors, architects, and university management to better understand the significant effect of ambient conditions on the learning effectiveness of university students. It provides empirical evidence to justify the importance of improving ambient conditions specially related to lighting and temperature to enhance learning effectiveness.

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