The Influence of Learning Environment on Academic Performance Among Undergraduate Students

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ABSTRACT

The learning environment plays an important role in supporting students' comfort, concentration, and academic performance. A conducive study environment with suitable lighting and furniture can help students study more comfortably and effectively. This study examines the relationship between lighting, furniture, and academic performance among undergraduate students. A sample of 397 undergraduate students was selected, and data were collected through a structured questionnaire. The data were analysed using Statistical Package for the Social Sciences (SPSS). The results showed that both lighting and furniture had significant positive relationships with students' academic performance. These findings highlight the importance of a suitable physical learning environment in supporting students' academic performance.

Keywords: physical ergonomics; lighting; furniture; academic performance.

INTRODUCTION

The physical study environment plays an integral role in shaping the learning experience and academic outcomes of higher education students. Among its components, ergonomic factors, particularly lighting and furniture, have received increasing research attention, as these elements can influence students' physical comfort, concentration, and ability to sustain prolonged academic activities (Latip&Tamrin, 2023). Physical ergonomics refers to the branch of ergonomics concerned with human anatomical, anthropometric, physiological, and biomechanical characteristics in relation to physical activities, including the design of workstations, furniture, and lighting systems (ISKU, 2024). Poor lighting and inappropriate furniture have been associated with eye strain, musculoskeletal discomfort, reduced concentration, and diminished academic performance (Odunaiya et al., 2014; Gilavand et al., 2016), whereas adequately lit and appropriately designed study spaces may contribute to greater comfort, focus, and productivity (Odunaiya et al., 2014).

This is particularly relevant in Malaysia, where higher education institutions provide diverse learning environments, and students' perceptions of their physical classroom environment have been shown to significantly relate to their learning experiences (Che Ahmad & Amirul, 2017). However, existing studies have often examined physical environmental conditions as broad composite constructs or focused primarily on school-level education, leaving the specific contribution of lighting and furniture to undergraduate academic performance in Malaysia insufficiently understood.

A clearer understanding of these relationships is important, as it may assist higher education institutions and facility planners in identifying physical ergonomic factors that require greater attention in supporting conducive learning environments. Therefore, this study examines the relationship between two specific physical ergonomic factors, lighting and furniture, and the academic performance of undergraduate students in Malaysia.

LITERATURE REVIEW

2.1 Academic Performance

A student's academic performance refers to the level of knowledge demonstrated in a particular subject compared with the expected standards based on their age and level of education (Jimenez, 1995). Academic performance is influenced by a wide range of factors, including psychological factors (motivation, self-efficacy), social factors (peer support, family background), and environmental factors, of which the physical study environment is an important but sometimes underexamined component (Wang & Chen, 2025). Within the physical environment literature, academic performance is often operationalised through self-reported measures capturing students' ability to organise time, stay focused on end goals, and complete tasks efficiently, an approach consistent with the present study's operationalisation of the construct.

2.2 Physical Ergonomics and the Learning Environment

Physical ergonomics is concerned with the interaction between individuals and elements of their physical environment, including furniture and lighting design, with the goal of optimising comfort, safety, and performance (ISKU, 2024). In educational settings, physical ergonomics specifically addresses how lighting and furniture design affect visual comfort, posture, and muscular strain, which in turn relate to students' ability to concentrate over extended study periods (ISKU, 2024). This provides the conceptual foundation for the present study's focus on lighting and furniture as two central dimensions of the physical ergonomic environment.

2.3 Lighting and Academic Performance

Lighting is one of the most extensively studied physical ergonomic factors in educational research. Adequate and well-designed lighting has been shown to relate to cognition, academic achievement, attention, working speed, and accuracy (Mogas-Recalde & Palau, 2021). Cheryan et al. (2014) identified lighting, along with temperature and noise, as one of the key physical classroom features that can be modified to support student achievement, noting that classrooms with more natural light have been associated with better performance outcomes.

In a related study, Singh et al. (2020) reported that classroom lighting conditions had a significant effect on students' academic performance, lending further support to the notion that physical lighting quality plays a meaningful role in student outcomes. Within the Malaysian context, Abdul Latip et al. (2025) similarly found that the quality of lighting in educational spaces was significantly associated with students' academic performance. Thus, the following hypothesis was formulated:

H1: There is a significant positive relationship between lighting and academic performance among undergraduate students in Malaysia.

2.4 Furniture and Academic Performance

Furniture design and comfort represent the second key dimension of the physical ergonomic environment examined in this study. Ill-fitted or poorly designed study furniture has been linked to faster physical fatigue, defective posture, and musculoskeletal disorders among students, which can, in turn, correspond with reduced concentration and poorer academic performance (Odunaiya et al., 2014). Anthropometric mismatch between students' body dimensions and standard furniture design has similarly been identified as a barrier to comfort and sustained academic engagement in university settings, particularly in computer laboratories and lecture halls where furniture is rarely adjustable to accommodate the full range of student body sizes (Saha et al., 2024).

Odunaiya et al. (2014) further noted that proper classroom ergonomics is needed to maintain good health and to support academic performance, learning, and motivation, which underscores the importance of comfortable, appropriately sized furniture for sustained concentration. Based on this evidence, the following hypothesis was formulated:

H2: There is a significant positive relationship between furniture and academic performance among undergraduate students in Malaysia.

2.5 Conceptual Framework

Based on the literature reviewed, this study proposes a conceptual framework in which academic performance is the dependent variable, associated with two independent variables: lighting and furniture. The framework is presented conceptually below:

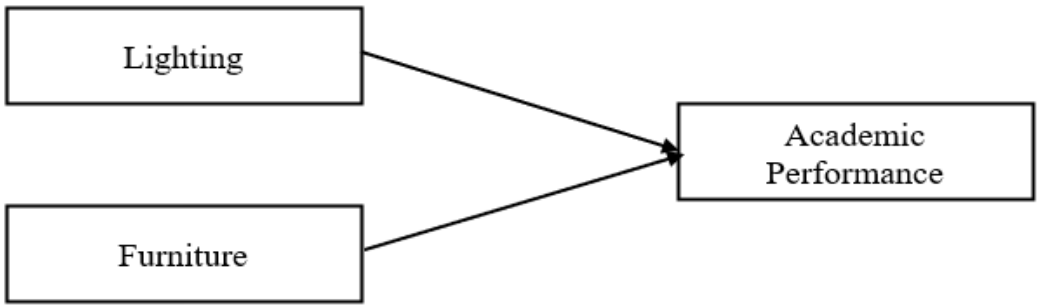


Figure 1: Conceptual Framework

METHODOLOGY

The study adopted a descriptive, cross-sectional research design using primary data collected through a self-administered, electronically distributed questionnaire. A convenience sampling technique was employed: undergraduate students who were accessible and willing to participate were invited to respond via the distributed link. Convenience sampling was adopted primarily for practical reasons, given the large and geographically dispersed population of undergraduate students across numerous higher education institutions in Malaysia, which made constructing a full probability-based sampling frame impractical within the resources available for this study.

To ensure the sample was nonetheless adequately sized for generalisation within these practical constraints, the minimum sample size was determined using the table proposed by Krejcie and Morgan (1970), which recommended a minimum of 384 respondents for a population of this size. A total of 397 valid responses were obtained after data screening, exceeding this minimum threshold. Nevertheless, because participation depended on accessibility and willingness rather than random selection, the sample may not fully represent the broader population of Malaysian undergraduates; this constraint is discussed further in the Limitations section.

DATA ANALYSIS

Respondents Profile

A total of 398 responses were received, of which 397 were complete and usable for analysis, resulting in a 99.7% usable response rate after one incomplete response was removed. Among the 397 respondents, 204 (51.4%) were female and 193 (48.6%) were male, indicating a relatively balanced gender distribution.

Reliability and Descriptive Analysis

Cronbach's alpha was computed to assess the internal consistency of each construct, alongside descriptive analysis for the composite scores. As shown in Table 1, all three constructs achieved Cronbach's alpha values above the acceptable threshold of .70, ranging from .735 (Furniture) to .752 (Academic Performance), indicating acceptable internal consistency across all measures. All three variables also displayed a negative skew, indicating that most respondents rated their academic performance and physical study environment somewhat favourably. Skewness and kurtosis values for all three variables fell within acceptable limits for normality.

Normality of the three composite variables was evaluated using skewness and kurtosis values, as formal significance tests for normality tend to be overly sensitive in large samples and often indicate statistical significance even for negligible departures. As reported in Table 1, the skewness and kurtosis values for all three composite variables fell comfortably within the criteria proposed by Hair et al. (2010), whereby skewness values within ±2 and kurtosis values within ±7 indicate no serious departure from normality. On this basis, the data were judged not to deviate severely from normality, supporting the appropriateness of proceeding with Pearson correlation and multiple linear regression, both of which are considered robust to moderate violations of normality in large samples.

Table 1: Summary of Reliability and Descriptive Statistics

Variable	No. of Items	Cronbach's Alpha	Mean	Std. Deviation	Skewness	Kurtosis
Academic Performance	4	.752	3.79	0.68	-0.99	2.03
Lighting	3	.737	3.85	0.74	-0.61	0.69
Furniture	3	.735	3.67	0.81	-0.31	0.14

Pearson Correlation Analysis

Pearson correlation analysis was conducted to examine the bivariate relationships between the independent variables (lighting, furniture) and the dependent variable (academic performance). As shown in Table 6, both independent variables were significantly and positively correlated with academic performance at the $p < .001$ level. Lighting showed the stronger correlation with academic performance ($r = .571$, $p < .001$), followed by furniture ($r = .527$, $p < .001$). Lighting and Furniture were also moderately correlated with each other ($r = .574$, $p < .001$), a level well below the .80 threshold commonly used as an indicator of multicollinearity concern

Table 2: Pearson Correlation Matrix

Variable	1	2	3
Academic Performance	1		
Lighting	.571**	1	
Furniture	.527**	.574**	1

Multiple Regression Analysis

Table 3 presents multiple regression analysis. The R^2 value for the two independent variables, lighting and furniture, was 0.385 (Adjusted $R^2 = 0.382$), indicating that these variables jointly explain approximately 38.5% of the variance in students' academic performance. The overall regression model was statistically significant, $F(2, 394) = 123.32$, $p < .001$. Both lighting ($B = 0.371$, $\beta = .401$, $t = 8.303$, $p < .001$) and furniture ($B = 0.250$, $\beta = .297$, $t = 6.146$, $p < .001$) emerged as statistically significant, positive predictors of academic performance, supporting H1 and H2 respectively.

Variance Inflation Factor (VIF) and Tolerance values were also examined to rule out multicollinearity between the two predictors: both variables returned identical VIF values of 1.49 (Tolerance = .67), well below the commonly used threshold of 5, indicating that multicollinearity was not a concern in this model. Consistent with this, the Pearson correlation between lighting and furniture was moderate ($r = .574$). Therefore, both hypotheses were supported: lighting and furniture were each independently and significantly associated with students' academic performance, with lighting showing the stronger association. The remaining variance may be explained by other factors not examined in this study, such as other environmental conditions (e.g., noise, temperature, and humidity), as well as individual factors such as motivation and study habits.

Table 3: Multiple Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.	Tolerance	VIF
	B	Std. Error	Beta				
(Constant)	1.446	0.152	-	9.520	< .001	-	-
Lighting	0.371	0.045	.401	8.303	< .001	.67	1.49
Furniture	0.250	0.041	.297	6.146	< .001	.67	1.49
F-value	123.3						
Sig.	< .001						
Adjusted R^2	.382						
R^2	.385						

DISCUSSION

This study examined the relationship between two physical ergonomic factors, lighting and furniture, and academic performance among 397 undergraduate students in Malaysia. The findings provide support for both of the study's hypotheses and offer several important insights.

Consistent with H1, lighting was a significant positive predictor of academic performance ($\beta = .401$, $p < .001$). This finding aligns with Singh et al. (2020), who reported a significant effect of classroom lighting on students' academic performance. It is also consistent with Abdul Latip et al. (2025), who found a significant relationship between lighting and academic performance within the Malaysian context. This suggests that Malaysian undergraduates who perceive their study environment as bright and adequately lit are more likely to report higher academic performance. As the present study used a cross-sectional design, this finding should be interpreted as an association rather than a demonstrated causal effect.

In addition, the finding that furniture was a significant positive predictor of academic performance ($\beta = .297$, $p < .001$) supports H2 and is in line with Odunaiya et al. (2014), who reported that unsuitable furniture can lead to discomfort, fatigue and loss of concentration, which may in turn affect academic performance. It also aligns with evidence on anthropometric mismatches between students and standard furniture design in university settings (Saha et al., 2024). The present finding suggests that furniture comfort is meaningfully associated with Malaysian undergraduates' reported ability to sustain focus and perform academically, although, as with lighting, this relationship should be interpreted as an association rather than a causal effect given the cross-sectional design. Notably, both lighting and furniture made distinct contributions, although lighting was the stronger predictor ($\beta = .401$ versus $\beta = .297$), and multicollinearity between them was low (VIF = 1.49), indicating that each captures a largely different aspect of the physical study environment.

The reliability and diagnostic checks reported in Data Analysis section support the appropriateness of the measurement instrument and regression model. Cronbach's alpha values above .70 for all three constructs confirmed acceptable internal consistency, while skewness and kurtosis values within the limits proposed by Hair et al. (2010) indicated no severe departure from normality. VIF values of 1.49 for both predictors further confirmed the absence of problematic multicollinearity, supporting the reliability of the regression coefficients reported above.

CONCLUSION

This study set out to examine the relationship between two physical ergonomic factors, lighting and furniture, and academic performance among 397 undergraduate students in Malaysia. The results showed that both lighting

and furniture were significant, independent, positive predictors of academic performance, together explaining 38.5% of the variance in academic performance. Lighting emerged as the stronger of the two predictors, though both factors made a meaningful and statistically significant contribution. These findings underscore the important role that the physical study environment plays in relation to students' academic outcomes, while also indicating that other factors beyond physical ergonomics, such as motivation, study habits, and psychological factors, likely account for a substantial share of the remaining variance. In conclusion, this study provides evidence that physical ergonomic factors, specifically lighting and furniture, are meaningfully and independently associated with the academic performance of undergraduate students in Malaysia. Although the cross-sectional design means these findings cannot establish causality, they reinforce the importance of thoughtfully designed physical learning environments in higher education and suggest that institutions seeking to support student academic outcomes may benefit from attending to environmental factors such as lighting and furniture, pending confirmation through experimental or longitudinal research.

LIMITATIONS OF THE STUDY

Several limitations should be acknowledged when interpreting these findings. First, the study employed a cross-sectional design, which precludes causal conclusions about the direction of the relationships observed; although the discussion above interprets patterns consistent with prior experimental literature, the present data themselves cannot establish causality. Second, academic performance was measured using self-reported perceptual items rather than objective indicators such as CGPA, which may be subject to social desirability or self-perception bias. Third, the use of convenience sampling limits the generalisability of the findings to the broader population of Malaysian undergraduate students. Lastly, the study focused on only two physical ergonomic factors; other relevant environmental variables, such as noise, temperature, and air quality, were not examined in this analysis and may also relate to academic performance.

RECOMMENDATIONS FOR FUTURE RESEARCH

Future research should consider adopting a longitudinal or experimental design, or a probability-based sampling strategy (e.g., stratified random sampling across a defined sampling frame of institutions), to establish clearer causal relationships between physical ergonomic factors and academic performance and to strengthen generalisability. Incorporating objective academic performance measures, such as CGPA or examination results, alongside self-reported perceptions would strengthen the validity of future findings. Finally, future studies should also report validity evidence (e.g., through formal pilot testing) alongside reliability statistics for all measurement instruments used, and should include a fuller set of regression diagnostics, including residual autocorrelation tests, to further strengthen methodological rigor.

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