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The Effect of Physical Ergonomic Factors on Stress among Students

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Abstract

This study used a quasi-experimental research design with a pre-post-test imbalanced group design to determine the influence of physical and ergonomic factors on student stress. The study sample included 130 students divided into two groups: the treatment and control groups. The primary research instrument of this study was a questionnaire that aimed to collect data on the stress experienced by students during TandL sessions due to ergonomic factors such as lecture hall temperature, lighting, and seating arrangements. The Statistical Package for Social Science (SPSS) was used to inferentially analyze the data of this study using the Dependent Sample t-test. The results showed that the seating arrangement (before the mean = 3.67; after the mean = 3.45; t = 4.057; P = 0.000), the lighting (before the mean = 2.85; after the mean = 2, 68; t = 2.582; P = 0.012).) and lecture room temperature (before mean = 3.35; after mean = 3.14; t = 2.675; p = 0.009) during the T&L session significantly influenced stress both before and after the test. Therefore, these factors must be considered to ensure students a comfortable teaching and learning environment, ultimately leading to a positive attitude.

Keywords: Physical Ergonomics, Stress, Learning Environment

Introduction

For students, an ergonomic learning environment is essential for the teaching and learning process (TandL). An ergonomic workplace is one of the most important elements affecting student productivity, and a thoughtfully designed learning environment can improve both academic performance and student well-being, claim (Ayyildiz & Taskin Gumus, 2021). According to research, a suitable and comfortable physical environment can increase students' motivation and concentration while reducing stress, fatigue, and discomfort (Realyvásquez-Vargas et al., 2020).

Ergonomic elements in the lecture hall, such as lighting, temperature, and seating arrangements, significantly impact how well students learn. The right temperature can relieve

pain and relieve tension even more. Students attending TandL sessions should be in a lecture hall with a temperature of 25 to 8 degrees Celsius (Larrea-Araujo et al., 2021). Previous research has shown that lowering the temperature in the lecture hall from 23 to 6 degrees Celsius to 20 degrees Celsius improves student performance (Ehrensberger-Dow, 2019). (Fakhari et al., 2021) subjective temperature assessments and physiological measurements indicate that air quality worsens as heat increases. In addition, there are signs of sick building syndrome, which include more depressed mood, decreased desire to work, poorer work performance, increased heart rate, significantly increased blood carbon dioxide levels, and decreased arterial oxygen saturation. (Ma et al., 2020) examined lecture halls and found that an appropriate temperature can improve teaching.

In everyday life, lighting is essential for people to function optimally in all environments. Lighting, therefore, directly impacts all facets of human life. After food and water, light is the most important input for regulating physical processes (Bakhtiar Choudhary et al., 2020). Students may feel uncomfortable during TandL sessions due to inadequate lighting. As reported by (Gumasing and Castro, 2023), good lighting improves performance on an individual basis.

Another ergonomic consideration relevant to the 21st-century approach to learning is the cluster seating arrangement, which can promote collaborative learning and, in turn, support student-centered learning in the classroom. According to research by (Paradina and Prasetyo, 2023), there are differences in peer aggression and behavior. Students sitting in groups are more likely to follow instructions, engage in social conversations, and cooperate with peers (Branco et al., 2024). Building relationships, facilitating interaction, planning and executing instructions, maintaining order, motivating students, maximizing learning, and disciplining inappropriate behavior is possible with effective classroom management (Ismail & Hassan, 2024)

It is important to consider the right ergonomic factors to create a conducive learning environment that can indirectly promote students' academic performance and overall well-being. Therefore, this study focuses on the influence of physical and ergonomic factors on student stress.

Ergonomics

Ergonomics is a profession that follows theories, principles, data, and techniques to maximize human well-being and overall system performance. Ergonomics is a scientific field that studies interactions between people and systems. The three main categories of ergonomics are organizational, cognitive, and physical (Gamper, 2022).

According to (Singleton, 2022), physical ergonomics studies how the human body responds to environmental biological elements, including temperature, sound, light, and air quality. This also includes planning workplace layouts, equipment, and tools to reduce the risk of accidents and injuries. The human mind's ability to process information and make decisions is part of cognitive ergonomics. It examines how people see, remember, learn, and make decisions (Branaghan & Lafko, 2020). Organizational ergonomics focuses on the design of work systems, including communication systems, work orders, and work schedules. This also includes analyzing the possible effects of the organizational structure and the working

environment on employees' safety, health, and productivity. The field of ergonomics is constantly expanding and changing as researchers discover more and more about how people interact with their environments. The temperature, lighting, and seating arrangement of lecture halls during teaching and learning (T&L) sessions are aspects of physical ergonomics that are the subject of this study.

A lecture hall's lighting, temperature, and seating arrangement are important aspects of physical ergonomics that impact student behavior and performance. While too bright or dim lighting can lead to visual fatigue and a decrease in concentration, appropriate lighting, incredibly natural light, has been shown to improve student concentration and eye comfort (Pradhan et al., 2024). Another important ergonomic aspect is the space. A temperature between 22°C and 24°C has been shown to improve student comfort and concentration, while extremely hot or cold temperatures can cause discomfort and interfere with learning (Jay et al., 2021). While group seating, such as a U-shape, has been shown to promote collaboration and communication more effectively, long rows of seats in the back can reduce student interaction with teachers and classmates (Higgins et al.). Considerations directly impact student behavior and performance in the classroom and demonstrate the importance of making the necessary adjustments.

According to research, poor lighting in classrooms is associated with poorer student performance. Additionally, improper lighting can impact student health and safety (Altalhi et al., 2020). Davis and Associates. (2020) also showed how poor lighting conditions can cause eye strain, burning, and redness, affecting students' concentration and overall health. In addition, ergonomics has an impact on a person's mental health. Stress and depression are associated with workplace lighting (Soltaninejad et al., 2021).

Classroom seating arrangements can encourage or limit interaction and provide a model for desired teacher behaviors. Students in a classroom must share resources, complete tasks, use materials, and operate in the same area, even though they have different goals, needs, and abilities.

Stress among Students

Stress is defined as "a non-specific reaction or response of the body to a request or desire" or a non-specific response by any part of the body to the existence of an urge (Hess & Copeland, 2001). This stress makes an individual lose focus, disrupts their thinking, and creates a feeling of restlessness that often interferes with their daily activities (Park et al., 2020). According to (Pervanidou and Chrousos, 2012), stress is not only experienced by adults, but students also experience it. When stress levels become too high among students, adverse health effects and decreased academic achievement will occur (Soares & Woods, 2020). This stress is caused by students feeling disappointed, worried, and hopeless about themselves or others, which is caused by various tasks and responsibilities they cannot complete well at school (Stewart et al., 1999).

Physical elements influencing student stress levels include lighting, temperature, and seating configurations (Ramón-Arbués et al., 2020). While poor lighting can hinder learning, good lighting can increase concentration and reduce eye strain. Uncomfortable temperatures can lead to fatigue and poor concentration. Additionally, well-organized and ergonomic

seating arrangements can increase student engagement and interaction while reducing stress levels. Therefore, controlling these physical aspects can promote a more encouraging learning atmosphere and reduce students' stress levels.

Methodology

This study used an unbalanced group pre-post test design as part of a quasi-experimental research design (Harnaeny, 2021). This design has always been used when studying the effectiveness of a program, module, or teaching strategy in various contexts that precluded experimental designs, especially in authentic educational environments (Field, 2021).

Study Samples

A total of 130 students took part in this study. According to Frisch (2019), this sample size met the minimum sampling requirements. The study used two different groups: the treatment group and the control group. Two groups of Bachelor of Science in Nursing students from the Faculty of Medicine, Sultan Zainal Abidin University (UniSA), participated in this study. Students in the first and second semesters of their first year of study were divided into two groups.

Data Collection and Research Instruments

The primary research instrument of this study was a questionnaire that aimed to collect data on the stress experienced by students during TandL sessions due to ergonomic factors such as lecture hall temperature, lighting, and seating arrangements. The study's questionnaire was divided into four sections, part A of which dealt with the demographics of the respondents. Part B, which includes eight points (B1-B8), explains how temperature affects stress. Part C, which included six items (C1–C6), addressed the effect of lighting on stress. The influence of seating arrangement on stress is discussed in Part D, which includes five points (D1–D5). The students were divided into a 67-member experimental group and a 63-member control group. The researcher collected information from each study sample using questionnaires. All data provided by respondents was collected within six weeks. A time interval of one week (pre-test) and six weeks (post-test) ensured that the respondents answered the questions relaxedly.

Data Analysis

The Statistical Package for Social Sciences (SPSS) was used to analyze the data. Inferential statistical analysis using the dependent samples t-test was used to analyze the data. This test was used to compare the experimental group's stress levels before and after the pre-and post-test in terms of temperature, lighting, and seating arrangement. The researcher first tested the variables for normality before beginning the inferential analysis. The requirement that the data for each variable be customarily distributed was one of the basic assumptions in multivariate analysis (Gao & Mi, 2022). The normality test was performed to determine whether certain variables or residuals of concern had a normal distribution.

Result

Recommended using Shapiro-Wilk, Kolmogorov-Smirnov, kurtosis, and skewness methods for normality testing (F. Hair Jr et al., 2014). The statistical techniques of skewness

and slope (Kurtosis) were used in this study because visual tests require thorough examination; otherwise, assumptions could be misinterpreted.

Table 1
Pre-Test Normality Results

Variables	Skewness	Kurtosis
Effect of Temperature on Stress	-0.332	-0.270
Effects of Lighting on Stress	0.238	-0.436
Effect of Student's Seating Position on Stress	-0.350	0.373

Table 2
Post-Test Normality Results

Variables	Skewness	Kurtosis
Effect of Temperature on Stress	-0.554	0.507
Effects of Lighting on Stress	0-.096	-0.148
Effect of Student's Seating Position on Stress	-0.182	0.320

The data distribution of all variables in the pre-and post-test met the assumption of normality according to Tables 1 and 2. A dependent sample t-test was used to examine how pre- and post-test stress affected the lecture hall's temperature, lighting, and seating arrangement during the TandL session for the treatment group. Table 4.3 shows the results of the analysis.

Table 3
Dependent Samples t-Test

Variables	Pre-Test Mean	Post-Test Mean	Mean Difference	t-Value	Sig. Level
Effect of Temperature on Stress	3.35	3.14	0.209	2.675	**0.009***
Effects of Lighting on Stress	2.85	2.68	0.169	2.582	**0.012***
Effect of Student's Seating Position on Stress	3.67	3.45	0.212	4.057	**0.000***

Table 3 shows significant differences between the effects of lecture hall temperature before and after the test on stress (mean before = 3.35; mean after = 3.14; t = 2.675; P = 0.009), lighting (mean before). =2.85; middle post=2.68; t=2.582; P=0.012) and sitting position (mean before=3.67; mean). post=3.45; t=4.057; P=0.000) during the TandL session. This showed that changing the lecture hall's lighting, temperature, and seating arrangement can help students feel less stressed.

Discussion and Conclusion

By comparing the experimental group's pre-and post-test scores, this study assesses how ergonomic changes- temperature, such as using and seating arrangements—affect students' stress levels. According to the study results, there was a significant difference

between stress levels before and after the test, suggesting that changing these environmental factors can reduce stress.

The experimental group's stress level was significantly lower after the test than the lecture room temperature. The procedure aims to reduce the temperature to the ideal range of 19 to 26 °C. This modification effectively reduces stress and is consistent with the study by (Altalhi et al., 2020), who found that maintaining the right temperature in the classroom can improve thermal comfort and reduce stress levels. By reducing stress and improving cognitive function, the results of this study show that ideal temperature control not only relieves physical discomfort but also increases academic performance.

Furthermore, this study found that using light-emitting diodes (LED) can significantly reduce the stress associated with lighting compared to traditional fluorescent lamps. LED lights improve lighting and reduce student stress levels. Ayyildiz and associates claim that ideal lighting can reduce stress and improve student comfort and performance, crediting this finding (Ayyildiz & Taskin Gumus, 2021). The importance of sufficient lighting for classroom activities is emphasized by standards such as the European standard EN 12464-1:2002 (E) and the Korean Standards Association (KSA) recommendations, which range from 300 to 600 lux. (Pradhan et al., 2024) I showed how appropriate lighting, such as fluorescent white light, can improve the learning environment, reduce stress levels, and positively impact student behavior. In this study, switching to LED lighting successfully solves problems with uneven or inadequate lighting and makes the learning environment more comfortable and less stressful.

In addition, the t-test results showed that the experimental group was less stressed about the seating arrangement. Instead of traditional row seating, students sit in groups of six to eight people. These adjustments reduce stress and promote improved interactions. Branaghan and associates. Emphasized that group seating arrangement promoted more casual and encouraging interaction between students and teachers and that seating arrangement had a significant impact on students' behavior and comfort (Jay et al., 2021). According to (Ramón-Arbués et al., 2020), well-organized seating arrangements can increase student engagement and reduce stress levels. (Bakhtiar Choudhary et al., 2020) Students who sit closer to the teacher, particularly in the front row, tend to be more engaged and active, improving interaction and performance.

Conclusion

A comprehensive picture of how the learning environment can affect students' emotions and motivation can be gained by examining the effects of the lecture hall's temperature, lighting, and seating arrangement on the stress levels of studying students. According to research, a comfortable lecture hall can help students feel less stressed and more motivated. Temperatures that are too hot or cold can affect well-being and concentration, increasing stress levels. Appropriate and sufficient lighting is also essential to ensure students' comfort and well-being. Good lighting improves concentration, eye fatigue, and stress relief (and student motivation increases). Choosing the right seats in the lecture hall is also crucial to reducing stress and increasing motivation. While a position that encourages interaction and information sharing can increase social interaction and learning engagement, an ergonomic position improves physical comfort. Good lighting, a comfortable temperature, and good seating placement are ideal lecture room conditions that increase

students' motivation to learn. Feeling comfortable in the classroom increases students' motivation to attend and actively participate in class.

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