Journal of Ecohumanism
2025
Volume: 4, No: 1, pp. 1116– 1125
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i1.5917

Sleep Quality in Academic Performance of Engineering Students

Pedro Pablo Rosales López[1], Mercedes Puca Pacheco[2], Enrique Tacuri Calanchi[3], Ismael Armando Arévalo Vega[4], Gonzalo Pablo Villa Lázaro[5], Valeria Luciana Mayandía Gayoso[6], Antony Tuesta Marín[7]

Abstract

This research corresponds to a completely randomized blocked factorial experimental design. The independent variable Sleep Quality is used as a factor and the Control of academic progress (evaluations) as blocks, the response variable is academic performance. The research was carried out at the Faculty of Industrial Engineering of a public university in the city of Lima - Peru. To determine the quality of sleep, the Pittsburgh Index was used and to determine the response variable, the average grades of the students from the first evaluations of the semester were used. The results were consistent with the hypotheses proposed by the authors, that is; sleep quality affects the academic performance of students.

Keywords: *Pittsburgh Index, Sleep Quality, Academic Performance.*

Introduction

Academic performance is a fundamental objective for students in their search for a successful education. However, various factors can significantly affect their ability to reach their full potential. A key factor is sleep quality. Where sleep quality refers to the amount and depth of sleep experienced by an individual.

In recent decades, there has been a growing interest in understanding how sleep quality can influence academic performance. Numerous studies have shown that lack of sleep can have a negative impact on students' cognitive and academic performance. Lack of sleep can result in difficulties concentrating, memory problems, and increased reaction time, which can directly affect the ability to learn and retain information.

As the academic community recognizes the importance of addressing these challenges, interventions and programs have been implemented to improve and manage sleep quality in educational settings. These interventions include sleep hygiene strategies, relaxation techniques, and time management. By addressing this factor, it is hoped to improve students' overall well-being and ultimately optimize their academic performance.

Regarding Sleep Quality, it can be said that sleep is a complete physiological program different from wakefulness, comprising two states, called slow sleep and REM (Rapid Eye Movement) sleep. Both states, sleep and wakefulness, involve physiological functions that must occur in a harmonious manner to ensure a healthy state. Furthermore, as Sierra points out, sleep is determined by four different dimensions: circadian time (that is, the time of day when it occurs); intrinsic factors of the organism (age, sex, sleep patterns, physiological state or need for sleep, among others); behaviors that facilitate or inhibit sleep; and

[1] Facultad de Ingeniería Industrial - UNMSM
[2] Facultad de Química e Ingeniería Química - UNMSM.
[3] Facultad de Química e Ingeniería Química - UNMSM.
[4] Facultad de Ingeniería Industrial - UNMSM.
[5] Facultad de Ingeniería Industrial - UNMSM
[6] Facultad de Ingeniería Industrial - UNMSM.
[7] Facultad de Ingeniería Industrial - UNMSM.

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the environment. The last two dimensions are related to sleep hygiene, which includes the practices necessary to maintain normal nighttime sleep and daytime alertness. [1]

Many factors affect the quality of sleep, among which we can consider; environmental factors, such as light, especially artificial light, noise intensity, extreme temperature, ambient air quality, seasonal changes, exposure to tobacco in closed environments, bed characteristics and pillow conditions, and room humidity; psychological factors such as depression, excitement, stress, anxiety and fear can also affect it; or biological factors such as pain, drug use, alcohol consumption, increased tea consumption and excessive coffee consumption, feeling hungry at night, overeating during the day, fatigue or effort; and social factors such as problems with family or close friends, financial difficulties, problems at school, university or work, permanent loneliness can also affect [2].

Sleep disorders have a prevalence of one third in the adult population, significantly affecting university students. In this population group, sleep disorders may be due to the demands of the number of hours of study, mainly during exams (Mansoor et al., 2019). In order to make effective use of these hours of study, they also need to have their cognitive resources and in particular their attentional processes as clear as possible. Insomnia is one of the characteristics of sleep disorders, which affects mental health. [3]

As for the side effects of sleep impairment, it can be said that the effects of sleep are not limited to the body itself, which is a need for neurological and health restoration, but influence the normal development and functioning of an individual in society, affecting work or school performance, psychosocial well-being and road safety, among others. Among the factors that can be affected by the decrease in sleep hours is the quality of sleep, which not only refers to sleeping well at night, but also includes good daytime functioning. Sleep quality acts as a limiting factor in ethical leadership activities and innovation behavior, so important for academic performance. [4]

It is important to note that inadequate sleep, whether in quality or quantity, is correlated with impaired daytime functioning due to drowsiness, attention deficit, memory dysfunction, both short and long term. Inadequate sleep is correlated with an increased risk of developing hypertension, obesity, diabetes, depression, but also accidents and injuries, and in adolescents it has been shown to be associated with an increased risk of self-harm, suicidal thoughts and suicide attempts. [5]

Sleep quality is one of the most widespread and least understood clinical aspects, so it is necessary to know more precisely the incidence and the factors that may be determining it. A study carried out in 1960 by the North American Cancer Society revealed that the average sleep duration of the population was between eight and nine hours. In 1995, the National Sleep Foundation observed a drop in the average sleep duration to seven hours. Contemporary evaluations observe that a large percentage of North American adults sleep six hours per night or less. A research carried out in Buenos Aires, Sao Paulo and Mexico City by Blanco et al. during 2004, has revealed that sleep disorders in Latin America are similar to those in other countries and that they affect all age groups, without gender differences. [6]

Poor academic performance in university students is something that must be addressed. Not only for the academic aspect but for the well-being of the children. The first thing that must be known is the cause in order to be able to find solutions. [7]

Sleep plays a fundamental role and it is proven that lack of sleep causes small mood swings, pessimistic attitude, stress and anxiety, which decreases the ability to learn and can cause sleep disorders.

It is necessary to educate about sleep from an early age, this will prevent us from reaching adolescence and having young people who are tired, apathetic, without desire to do anything, without motivation.

Let's say that we reach a chronic lack of sleep that has to be avoided with guidelines set from childhood. The decrease in sleep time is a very general problem, not only in children and young people, but also in adults.

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It seems as if sleep is something that we can lose when we lack time for other things and that is what usually happens in today's society, that we lack time for many things and we take time away from sleep. Various studies have determined that many college students do not get enough sleep. The origin of this deficit can be due to overloaded schedules or other causes such as watching television until late or misuse of cell phones and other electronic devices at night.

As for the importance of sleep, it is always necessary to sleep in order to think clearly, react quickly and create memories. In fact, the brain pathways that help us learn and remember are very active while we sleep. Skimping on sleep has its price. Cutting back on just 1 hour of sleep can make it difficult to concentrate the next day and slow down your response time. Studies have shown that due to lack of sleep, you are more likely to make bad decisions and take unnecessary risks. This can result in poor performance at work or school, and a higher risk of car accidents. [8]

The COVID-19 pandemic changed some patterns, for example; many people's sleep duration increased, but sleep quality decreased. More attention should also be paid to how people can achieve good quality sleep, including restful sleep, no daytime sleepiness, and adequate objective sleep depth. [9]

Sleep also affects mood. Lack of sleep can lead to irritability, which can affect behavior and relationship difficulties, especially in children and teens. In addition, people who are chronically sleep deprived are more likely to suffer from depression. Sleep is important for good health.

Studies show that not getting enough sleep or consistently getting poor quality sleep increases the risk of high blood pressure, heart disease, and other medical conditions. Additionally, during sleep, your body produces valuable hormones. These hormones contribute to children's growth and help adults and children build muscle mass, fight infections, and repair cells. Hormones released during sleep also affect how the body uses energy. Studies show that the less sleep a person gets, the more likely they are to gain weight or become obese, develop diabetes, and prefer to eat high-calorie, high-carbohydrate foods.

To measure sleep quality, there are several methods, among the most commonly used are: the Insomnia Severity Index (ISI), the Sleep Condition Indicator (SCI), and the Pittsburgh Sleep Quality Index (PSQI). [10]

As for the Pittsburgh Index, also known as the Pittsburgh Sleep Quality Index (PSQI), it is a widely used questionnaire to assess sleep quality in adults. It was developed by Buysse, Reynolds, Monk, Berman, and Kupfer in 1989 and has been validated in different populations.

Regarding the components of the PSQI, the PSQI consists of several dimensions that assess different aspects of sleep quality. These dimensions include subjective sleep quality, sleep latency (time taken to fall asleep), sleep duration, sleep efficiency (proportion of time spent asleep relative to total time in bed), sleep disturbances, use of sleep medication, and daytime dysfunction. [11]

For the scoring and interpretation of the PSQI, each of the PSQI dimensions is scored separately, and the scores are summed to obtain an overall score ranging from 0 to 21. A higher score indicates poorer sleep quality. In addition, the PSQI provides a classification into seven main components, allowing for a more detailed interpretation of specific sleep problems. [12]

There are many applications and research with the PSQI, the PSQI has been used in numerous studies to investigate sleep quality in various populations, such as patients with sleep disorders, patients with chronic diseases, older adults, students, and workers. In addition, it has been used in research related to mental health, cognitive performance, quality of life, and the effects of interventions to improve sleep. [13]

Methodology

This research work was developed in a public university in the city of Lima – Peru. For convenience, we worked with engineering students, belonging to the Industrial Engineering degree. The hypothesis proposed

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in this research was: Sleep quality influences the academic performance of young university students from the Faculty of Industrial Engineering of a public university in Lima – Peru.

Regarding the control factors used, sleep quality was considered as an independent variable, expressed in hours of sleep. For this factor in the research, 3 treatments are being considered, that is, for sleep quality, the following are taken into account: Low sleep quality, Regular sleep quality and Poor sleep quality.

Two blocks are also being considered in this research, consisting of the control evaluations carried out at the Faculty, to determine the progress of the student's academic performance, the first block is the Qualified Practical Grade (PC), which is carried out at 25% of the course progress and the second block is the Partial Exam Grade (EP), which is carried out at 50% of the course progress.

There was the possibility of randomly selecting a course from the Industrial Engineering degree, however, it was decided to segment courses of higher than average complexity in a first stage, and in a second stage, the Planning, Programming and Operations Control course was randomly selected. Therefore, the sample corresponded to students regularly enrolled in the Planning, Programming and Operations Control course of the Faculty of Industrial Engineering.

The response variable of the present research is the academic performance of the student, expressed in the weighted average of the progress of the course. Regarding the external factors identified in the present research, they are: the subject or course, the age of the student and the academic environment provided by the university. In all cases, the external factors are controlled, in such a way that they do not affect the research.

Sleep is a physiological state of importance for the optimal development of the human being, it is known that an alteration in this or deprivation generates negative repercussions in the functioning of the individual in daily activities. Lack of quality sleep can result in decreased concentration, memory, and cognitive processing capacity, which directly impacts academic performance.

Results

Data collection during the time the research was conducted was done through the use of a Google form, that is, a survey was conducted to students with regular enrollment who are taking the Planning, Programming, and Operations Control course in all sections, questions from the Pittsburgh questionnaire were used to determine the level of sleep quality, additionally the grades of their partial exam and graded practice were requested from the faculty authorities. From Image 1 to Image 7, the results are shown, summarized for each question of the Pittsburgh questionnaire.

First question: During the last two months, how many hours do you sleep regularly?

Image 1. Summary of the Results of Question 1

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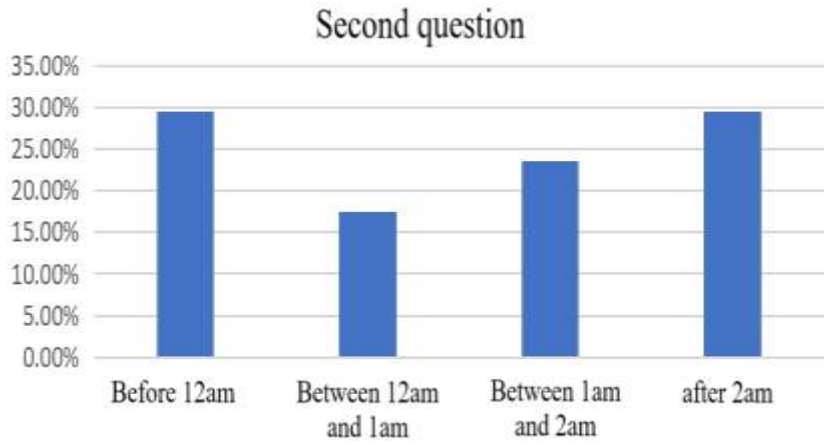
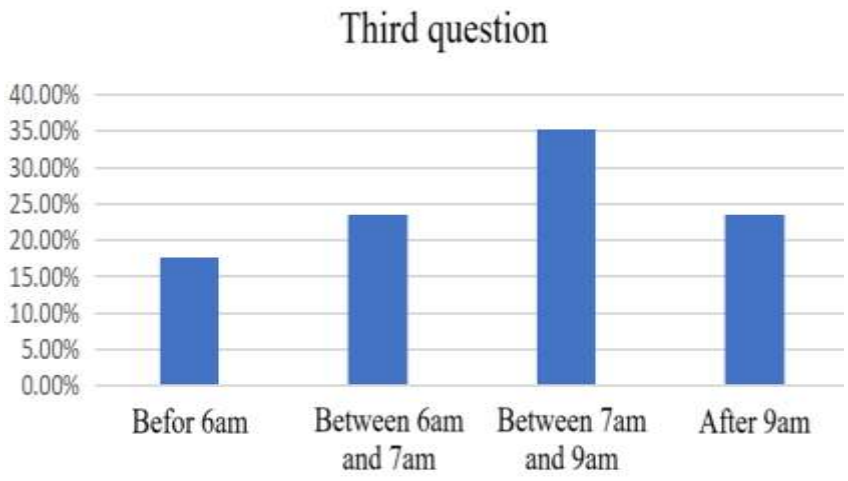
Second question: During the last two months, what has been your normal bedtime?

Image 2. Summary of Results for Question 2



Third question: During the last two months, what time have you usually gotten up in the morning?

Image 3. Summary of the Results of Question 3



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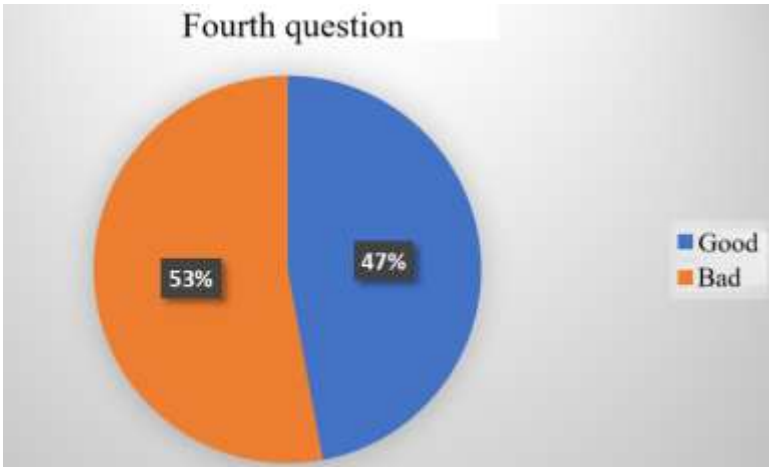
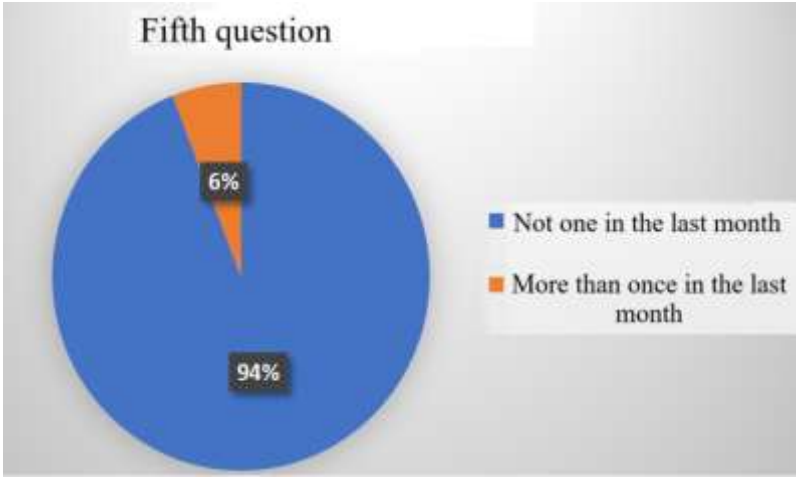
Question 4: How would you rate the overall quality of your sleep over the past two months?

Image 4. Summary of Results for Question 4



Question 5: During the past two months, how many times have you taken medicine (on your own or prescribed by your doctor) to help you sleep?

Image 5. Summary of Results for Question 5



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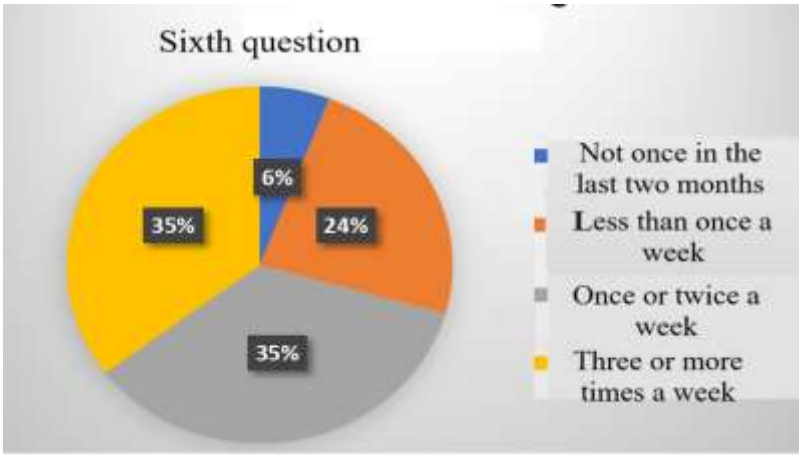
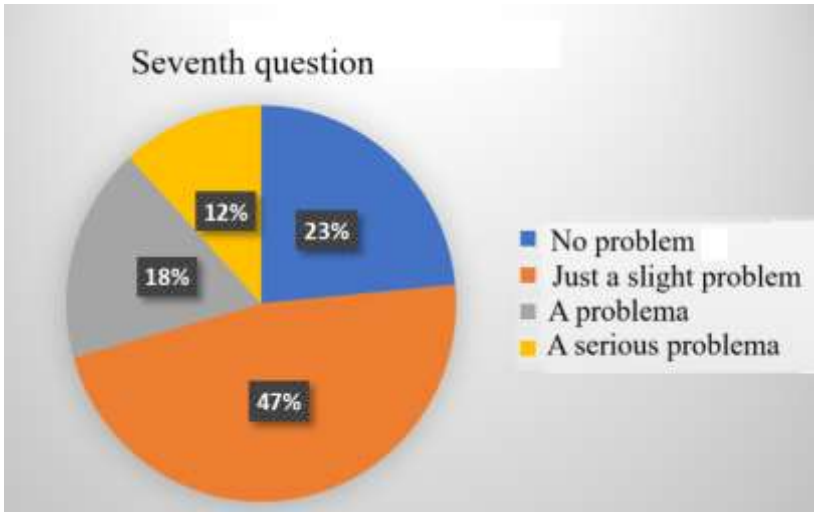
Sixth question: During the last month, how many times have you felt drowsy while driving, eating, or doing another activity?

Image 6. Summary of Results for Question 6



Seventh question: During the last two months, have you had much trouble "keeping your spirits up" for some of the activities detailed in the previous question?

Image 7. Summary of the Results of Question 7



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With the data collected, the information was organized through the averages of the students who had low, medium and good quality of sleep as shown in Table 1.

Table 1. Summary of the Information Collected

Feed control		Sleep quality sleep quality		
		Good	Medium	Low
PC1	Sec1	14.91	12.88	11.50
	Sec2	13.25	12.30	9.00
EP	Sec1	14.91	12.13	9.50
	Sec2	12.19	10.50	8.00

Assuming normality of the data, in a block factorial experimental design, a 2-factor ANOVA test was performed: sleep quality and academic progress control. The results of this test can be seen in Table 2.

Table 2. ANOVA Test

Tests for inter-subject effects

Dependent variable: Weighted average

Origin	Type III Sum of Squares	gl	Root Mean Square	F	Sig.
Corrected model	41,627[a]	5	8.325	4.615	0.045
Intersection	1658.395	1	1658.395	919.318	0.000
AC Academic Control	3.641	1	3.641	2.018	0.205
SQ Sleep quality	37.471	2	18.735	10.386	0.011
Interaction AC * SQ	0.516	2	0.258	0.143	0.870

a. R squared = 0.794 (Adjusted R squared = 0.622)

By analyzing the results, we can say that the calculated value of F in the columns (sleep quality) is 10.38 and is greater than 5.14, the value of the Fisher tables, therefore, it is concluded that there is a significant difference in the average grades (weighted average) between students who have a better quality of sleep with those who have a poor quality of sleep.

It is also concluded that the F value for the exams (academic control) is lower than the value of the Fisher tables, therefore, it is concluded that between PC1 and EP there is no significant difference between both averages obtained by the students.

Now with respect to the average of the students obtained in the combination of both factors, exams and sleep quality, the value of F is 0.142 and is lower than the critical value for F, which is 5.14. Therefore, it is concluded that there are no significant differences, that is, students who have a good quality of sleep get better grades regardless of whether it is EP or PC1, in the same way that students who have a low quality of sleep continue to get low grades in their exams, regardless of which one it is.

Discussion of Results

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In Kheirinejab's research, he analyzes the quality of sleep and the influence that technology has, specifically digital services. The findings are similar, the quality of sleep can be affected by digital well-being. Kheirinejad says that sleep plays a crucial role in the quality of human daily life, and sleep hygiene is an essential part of daily routines. Sleeping well and having good sleep hygiene can improve brain functionality, memory and cognitive abilities. Excessive use of technology can interrupt these daily activities. [2]

In the work published by Chandra, in India, he found that, in civil construction workers, there is a correlation between sleep quality, rational skills and their cognitive behavior. Similarly, in this work we found a relationship between sleep quality and academic performance, which are based on rational skills and cognitive behavior. [9]

While it is true that the results obtained in this research refer to the academic performance of young university students, which deteriorates when sleep quality is not good, Rusu reached similar conclusions, applied to the physical performance of young athletes, at ages similar to the sample used in this research. [14]

Conclusions

- Sleep quality has a significant impact on the academic performance of university students from the Faculty of Industrial Engineering of a public university.
- The results of the study support the hypothesis raised and confirm that better sleep quality is associated with better academic performance.
- Students who experience poor sleep quality are more likely to face difficulties in their academic performance. Lack of adequate sleep can negatively affect concentration, memory, and problem-solving skills, which in turn impacts performance in Industrial Engineering-related subjects.
- Implementing measures to improve sleep quality among Industrial Engineering students can have a positive impact on their academic performance.
- Interventions aimed at promoting healthy sleep habits and raising awareness about the importance of adequate rest can be beneficial in improving students' academic performance.

Recommendations

- Awareness of the importance of sleep should be promoted. We are not just talking about long sleep but quality sleep. This can be promoted through informative posters about the benefits of a good nap.
- It is recommended to establish schedules according to your daily routine to help define a time to get up and go to bed, this in turn will promote good sleep quality.
- It is recommended to take into account the sleep environment. It is important to leave electronic devices on and not leave lights on that can cause disturbances.
- In addition, a cool and tidy bedroom should be kept promoting a calm environment.
- It is suggested to engage in regular physical activity, as it has been shown that exercise improves sleep quality. These activities can range from walking or yoga to soccer or basketball.

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