Influence of Sleep Quality on Mathematics Performance: An Experimental Study

Arlene E. Conversion[1], Romulo G. Doronio[2]

[1]Junior High School Teacher, Department of Education, Philippines

[2]Faculty, Assumption College of Nabunturan, Philippines

DOI: https://dx.doi.org/10.47772/IJRISS.2025.907000150

Received: 29 June 2025; Accepted: 07 July 2025; Published: 05 August 2025

ABSTRACT

This quasi-experimental study examined the influence of sleep quality on students' mathematics performance over a three-month period. A total of 78 junior high school students participated in the study. Their sleep quality was assessed monthly using the Pittsburgh Sleep Quality Index (PSQI), while mathematics performance was measured through test scores administered in January, February, and March. Statistical analyses were used to examine the relationship between sleep quality and academic achievement, as well as differences in sleep quality across socio-economic status and sex. The Pearson correlation analysis revealed no significant relationship between PSQI scores and mathematics test scores. Furthermore, a one-way ANOVA showed no significant differences in sleep quality across socio-economic groups, and an independent samples t-test indicated no significant difference between male and female students. These results suggest that sleep quality did not significantly impact mathematics performance in this context. It is recommended that future research include larger and more diverse samples, extended study durations, and additional variables such as stress levels, screen time, and study habits to better understand the factors influencing academic achievement.

Keywords: mathematics teaching, sleep quality, mathematics performance, PSQI, academic achievement, socio-economic status, quasi-experimental

INTRODUCTION

In the modern digital age, many students tend to undervalue the importance of sleep as they try to balance academic demands, extracurricular activities, and personal interests. Sleep is a vital physiological function essential for cognitive processing, memory consolidation, and overall mental well-being (Alimova et al., 2025). It allows the body and mind to recover from daily stressors. Secondary school students often experience significant variations in sleep patterns due to the combined pressures of schoolwork and extracurricular commitments. Additionally, increased exposure to gadgets, devices, and other technologies further disrupts sleep habits. As a result, inadequate or irregular sleep can impair cognitive functions such as memory retention and problem-solving skills that are especially critical in subjects like Mathematics.

The American Academy of Pediatrics (AAP) recommended in a 2014 policy statement that middle and high schools adjust their start times to allow students to obtain sufficient sleep, thereby enhancing their overall health, safety, academic performance, and quality of life (Wheaton et al., 2016). Despite this, less than one-third of high school students in the United States get at least eight hours of sleep on school nights, indicating that inadequate sleep remains a typical occurrence among this demographic (Owens et al., 2017). Several studies in the United States and other countries have shown that poor sleep quality negatively affects student achievement, particularly in subjects like Mathematics that require high cognitive functioning.

In the Philippines, similar trends are observed. Bucag (2021) found that a significant number of senior high school students in selected schools in Quezon City were sleep-deprived, often getting less than six hours of sleep per night. The main reasons for their late bedtimes included the use of social media platforms such as Facebook and Messenger, as well as mobile gaming. The study reported a significant negative correlation

between sleep duration and classroom sleepiness, and a positive correlation between sleep duration and academic performance. These findings highlight the need to examine how sleep affects learning in the Philippine context, particularly in subjects like Mathematics, where sustained performance is essential for academic success.

Building on these national findings, the researcher observed similar signs of sleep deprivation among her Grade 8 STE students at Agusan del Sur National High School, such as fatigue, reduced concentration, and disengagement during lessons. In one instance, a student who consistently struggled to focus reported that insufficient sleep and insomnia were the primary causes of their inattention. This personal observation further underscores the pervasive impact of sleep quality on academic performance, particularly in cognitively demanding subjects like Mathematics.

Despite awareness of sleep's role in learning, limited experimental studies in the Philippines have explored how sleep quality affects Mathematics performance, especially among junior high school students. Existing local research often employed descriptive designs and focused on general academic outcomes. To address this gap, the present study adopts an experimental approach to examine the influence of sleep quality on Mathematics achievement. The findings aim to inform school policies, assist parents and educators in promoting healthier sleep habits, and support academic success among Filipino learners.

Research Objectives

1. What is the profile of the subjects in terms of:
1.1. Sex
1.2. Socio-economic Status

2. What is the level in PSQI scores of the subjects over a three-month period?

3. What is the proficiency in mathematics test scores of the subjects over the same three-month period?

4. Is there a significant relationship between the PSQI scores and mathematics test scores of the subjects?

5. Is there a significant difference in Pittsburgh Sleep Quality Index when grouped according to sex?

6. Is there a significant difference in the Pittsburgh Sleep Quality Index when grouped according to socio-economic status?

METHODOLOGY

This quasi-experimental study aimed to investigate the influence of sleep quality on mathematics performance among students over a three-month period. The independent variable, sleep quality, was measured using the Pittsburgh Sleep Quality Index (PSQI), while the dependent variable, mathematics performance, was assessed through teacher-constructed math test scores. Each participant completed the PSQI questionnaire and took a math test at the end of each month, resulting in three measures of the sleep quality index and three corresponding test scores.

According to Creswell and Creswell (2017), a quasi-experimental design is suitable when random assignment is impractical, but the research still aims to investigate causal relationships within naturally occurring groups. In this study, participants were chosen from pre-existing classrooms without the use of random assignments to create treatment or control groups. This approach facilitated the examination of the relationship between sleep quality and mathematics performance in a real-world educational context.

To enhance internal validity, potential confounding variables such as sex and socio-economic status were considered as moderating factors. A repeated measures approach, which involves multiple observations of the same participants over time, was used to detect changes and patterns in the relationship between sleep quality and academic outcomes. According to Field (2013), repeated measures designs are particularly useful in educational research for tracking within-subject changes across time. By employing this design, the study aimed to generate practical insights into how variations in sleep quality affect academic achievement, thereby informing interventions that support student learning and performance.

Research Subjects

The research subjects of this study were Grade 8 students enrolled in the Science, Technology, and Engineering (STE) Program at Agusan del Sur National High School for the school year 2024–2025. A total of eighty (80) students were enrolled in the Grade 8 STE Program, which was composed of two sections. However, only seventy-eight (78) students participated in the study due to personal circumstances. Section Aristotle consisted of twelve (12) male and twenty-eight (28) female students, while Section Linnaeus comprised eleven (11) male and twenty-seven (27) female students. Overall, a total of seventy-eight (78) students took part in the research.

Table 1. Research Subjects of the study

Sections	Male	Female	Total
Aristotle	12	28	40
Linnaeus	11	27	38
Total	**23**	**55**	**78**

Statistical Tool

The following statistical tools were employed to address the specific research questions of the study:

Frequency and percentage were used to determine the profile of the respondents in terms of sex and socio-economic status. These measures provided a clear overview of the distribution and demographic composition of the subjects involved in the study.

Mean and standard deviation were also used to summarize the mathematics test scores of the respondents over the specified three-month period. These measures provided insight into the average performance of the students as well as the variability of their scores across the different months of the study.

Pearson Product-Moment Correlation Coefficient was employed to assess the relationship between the Pittsburgh Sleep Quality Index (PSQI) scores and mathematics test scores of the respondents. This test was chosen to measure the strength and direction of the linear relationship between the two continuous variables.

Independent Samples t-test was utilized to determine whether there is a significant difference in PSQI scores when grouped according to sex. This test is appropriate for comparing the means of two independent groups.

One-Way Analysis of Variance (ANOVA) was used to determine whether there is a significant difference in PSQI scores when grouped according to socio-economic status. The same statistical tool was also used to test the significant differences in mathematics test scores across socio-economic groups. ANOVA is suitable for comparing the means of three or more independent groups.

RESULTS

Profile of the Subjects

Shown in Table 2 the sample consisted of 78 student respondents. Of these, 23 students (29%) were male, and 55 students (71%) were female, indicating that most of the participants were female.

Table 2. Sex Profile of the Subjects

SEX	FREQUENCY	PERCENTAGE
Male	23	29%
Female	55	71%
TOTAL	78	100%

Further, as shown in Table 3, the largest proportion of students (n = 21, 27%) came from families classified as middle class, followed by 19 students (24%) in the lower middle class and 14 students (18%) in the low-income group. The remaining participants were distributed among the poor (n = 5, 6%), upper middle income (n = 9, 12%), high income (n = 6, 8%), and rich (n = 4, 5%) classifications. These results suggest that the sample included students from a variety of socio-economic backgrounds, with a majority falling within the middle-income brackets.

Table 3. Family's Monthly Income of Subjects

MONTHLY INCOME RANGE	CLASSIFICATION	FREQUENCY	PERCENTAGE
Less than ₱10,957	Poor	5	6%
₱10,957 – ₱21,194	Low Income	14	18%
₱21,194 – ₱43,828	Lower Middle Class	19	24%
₱43,828 – ₱76,669	Middle Class	21	27%
₱76,669 – ₱131,484	Upper Middle Income	9	12%
₱131,484 – ₱219,140	High Income	6	8%
₱219,140 and above	Rich	4	5%
TOTAL		78	100%

Sleep Quality of the Subjects

Presented in Table 4 the summary of the students' sleep quality across the three-month period based on their mean PSQI scores. Results show that 57 students (73%) had poor sleep quality and only 21 students (27%) achieved good sleep quality. The overall mean PSQI score for the group across the three months was 7.16, which falls within the poor sleep quality range, suggesting that most students experienced suboptimal sleep during the observed period.

Table 4. Mean PSQI Score of the Subjects over the 3-Month Period

PSQI SCORE RANGE	DESCRIPTION	FREQUENCY	PERCENTAGE
0 to 5	Good Sleep Quality	21	27%
6 to 21	Poor Sleep Quality	57	73%
TOTAL		78	100%

Proficiency in Mathematics of the Subjects

Shown in Table 5 the cumulative distribution of students' Mathematics scores averaged over the three-month period. Nearly half of the students, 38 (49%), had mean scores within the 16–20 range, while 27 students (34%) reached the highest range of 21–25. A smaller proportion, 13 students (17%), had average scores in the

11–15 bracket. No students fell below the 11–15 range across the entire observation period. The overall mean score was 18.87, indicating a generally proficient level of performance in Mathematics among the students.

Table 5. Mean of Mathematics Test Scores of Subjects over the 3-Month Period

TEST SCORES RANGE	FREQUENCY	PERCENTAGE
0 – 5	0	0
6 – 10	0	0
11 – 15	13	17%
16 – 20	38	49%
21 – 25	27	34%
TOTAL	78	100%

Significance of the Relationship between Sleep Quality (PSQI) and Proficiency in Mathematics Test

Table 6 presents the results of the Pearson correlation analysis conducted to determine the relationship between students' sleep quality, measured by their Pittsburgh Sleep Quality Index (PSQI) scores, and their proficiency in Mathematics based on test scores. It reveals a very weak negative correlation between PSQI scores and Mathematics test scores, r(78) = – .051, with a p-value of .660. Since the p-value is greater than the standard alpha level of .05, the result is not statistically significant. This indicates that there is no meaningful linear relationship between the students' sleep quality and their performance in Mathematics during the period covered by the study.

Table 6: Sleep Quality (PSQI) and Proficiency in Mathematics Test

Variables	Sample Size (N)	Pearson Correlation Coefficient (r)	Significance (p-value)	Remarks
PSQI Test Score	78	- .051	.660	Not significant

Difference in Sleep Quality (PSQI) by Sex

Shown on Table 7 Independent Sample Test Comparing PSQI by Sex. Levene's test for equality of variances was not significant, F(1, 76) = 1.333, p = .252, indicating that the assumption of equal variances was met. Using the equal variances assumed row, the t-test result showed no statistically significant difference in PSQI scores between male and female students, t(76) = –1.34, p = .185. The mean difference of –0.86 (95% CI: –2.14 to 0.42) suggests a small effect, but not one that is statistically meaningful

Table 7: Independent Sample Test Comparing PSQI by Sex

Assumption	Equal variances assumed
F	1.333
Sig. (Levene)	.252
t	-1.337
df	76
Sig.	.185

(2-tailed)	
Mean Difference	-.86140
Std. Error Difference	.64445
95% CI Lower	-2.14493
95% CI Upper	.42214

Difference in Sleep Quality (PSQI) by Socio-economic Status

Presented in Table 8 the result that the differences were not statistically significant, $F(6, 71) = 1.074$, $p = .386$. This indicates that socio-economic status did not have a significant effect on the sleep quality of the students in the sample. While there were observable variations in PSQI scores across socio-economic groups, these differences were not statistically significant, suggesting that sleep quality was relatively consistent regardless of socio-economic classification. Additionally, the coefficient of 0.220 indicates that a one-unit increase in affective state resulted in a corresponding rise of 0.220 in mathematical efficiency of the senior high school students.

Table 8: One-Way ANOVA Comparing PSQI Across Socio-economic Status Level

	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	43.592	6	7.265	1.074	0.386
Within Groups	480.347	71	6.765		
Total	523.939	77			

DISCUSSIONS

Profile of the Subjects

Majority of the subject group were female and belonged predominantly to the middle and lower-middle socio-economic classes. These demographic characteristics reflect a typical composition for public science-focused programs in the Philippine secondary education context.

Sleep Quality of the Subjects

The overall sleep quality of students, as measured by the Pittsburgh Sleep Quality Index (PSQI), was found to be poor across the three-month period. Although there was a gradual increase in the proportion of students reporting good sleep quality from January to March, the mean PSQI score remained above the threshold, indicating poor sleep. This suggests that most students were not getting sufficient or high-quality sleep consistently. These findings reflect existing research that points to a high prevalence of sleep issues among adolescents due to academic stress and inconsistent sleep patterns (Maheshwari & Shaukat, 2019; Hysing et al., 2016).

Proficiency in Mathematics of the Subjects

Students demonstrated a generally proficient performance in Mathematics. There was a notable improvement in test scores over the three-month period, indicating academic growth and possible adaptation to the curriculum or testing conditions. This trend supports prior findings that cognitive skills critical to Mathematics such as memory, reasoning, and problem-solving can improve over time through sustained learning and practice (Silver, 2013; Butterworth, 2005).

Significance of the Relationship between Sleep Quality (PSQI) and Proficiency in Mathematics Test

The correlation between sleep quality and mathematics performance was weak and not statistically significant. This suggests that, within the scope of this study, sleep quality was not a strong predictor of performance in mathematics among Grade 8 STE students. This result aligns with studies by Alotaibi et al. (2020) and Jowkar et al. (2022), which also found no significant associations between sleep quality and academic outcomes. Conversely, it contradicts findings from Urrila et al. (2017) and Jalali et al. (2020), who reported that students with better sleep quality tended to perform more successfully in academic subjects, citing the role of sleep in memory consolidation and attention regulation (Walker, 2009; Ellenbogen et al., 2006). The findings indicate that other factors such as study habits, motivation, or external support may have played a more dominant role.

Difference in Sleep Quality (PSQI) by Sex

Sex-based differences in sleep quality were also examined. Although female students had slightly poorer sleep quality scores than male students, the difference was not statistically significant. This implies that sex was not a major factor influencing sleep quality in the context of this student population. This aligns with McDevitt et al. (2013), who found no significant sex-based differences in adolescent sleep patterns. However, it contrasts with studies that link poorer sleep quality in females to hormonal, psychological, and behavioral factors (Galland et al., 2017; Landis & Lent, 2006).

Difference in Sleep Quality (PSQI) by Socio-economic Status

The one-way analysis of variance (ANOVA) was conducted to examine sleep quality across different socio-economic status groups. No significant differences in sleep quality were found across socio-economic status groups. While variations in mean PSQI scores were observed, these were not statistically meaningful, suggesting that socio-economic status did not significantly affect students' sleep quality in this study. This finding is consistent with literature suggesting that socio-economic status related sleep disparities are context-dependent and not always evident in adolescent populations (Jalali et al., 2020; McDevitt et al., 2013).

CONCLUSION

The findings of the study showed that most of the Grade 8 STE students had poor sleep quality. However, their level of sleep quality did not significantly affect their performance in mathematics. Additionally, there were no significant differences in sleep quality when grouped according to sex or socio-economic status. These findings suggest that, based on the responses of the participants, sleep quality alone did not play a major role in influencing their academic performance in mathematics during the period of the study. Other possible influences on their performance were not covered in this study and may require further investigation.

REFERENCES

1. Alimova, M., Djyanbekova, F., Meliboyeva, D., & Safarova, D. (2025). BENEFITS OF SLEEP. Modern Science and Research, 4(4), 780–789. Retrieved from https://inlibrary.uz/index.php /science-research/article/view/7959
2. Alotaibi, A., Alosaimi, F., Alajlan, A., & Abdulrahman, K. B. (2020). The relationship between sleep quality, stress, and academic performance among medical students. Journal of Family and Community Medicine, 27(1), 23. https://doi.org/10.4103/jfcm.jfcm_132_19
3. Bucag, B. (2021). The impact of social media on sleep quality among senior high school students in selected schools in Quezon City, Philippines. Journal of Education and Practice, 12(7), 40-50. Retrieved from https://www.iiste.org/Journals/i ndex.php/JEP/art icle/view/55710
4. Butterworth, B. (2005). The Development of Mathematical Cognition. In K. J. Holyoak & R. G. Morrison (Eds.), The Cambridge Handbook of Thinking and Reasoning.
5. Ellenbogen, J. M., Hulbert, J. C., Stickgold, R., Dinges, D. F., & Thompson-Schill, S. L. (2006). Interfering with theories of sleep and memory: sleep, declarative memory, and associative interference. Current Biology, 16(13), 1290-1294

6. Galland, B. C., Gray, A. R., Penno, J., Smith, C., Lobb, C., & Taylor, R. W. (2017). Gender differences in sleep hygiene practices and sleep quality in New Zealand adolescents aged 15 to 17 years. Sleep Health, 3(2), 77–83. https://doi.org/10.1016 / j. sleh.2017.02.001
7. Hysing, M., Harvey, A. G., Linton, S. J., Askeland, K. G., & Sivertsen, B. (2016). Sleep and academic performance in later adolescence: results from a large population-based study. Journal of Sleep Research, 25(3), 318–324. https://doi.org/10.1111/jsr.12373
8. Jalali, R., Khazaei, H., Paveh, B. K., Hayrani, Z., & Menati, L. (2020). The Effect of Sleep Quality on Students' Academic Achievement. Advances in Medical Education and Practice, 11, 497–502. https://doi.org/10.2147/AMEP.S261525
9. Jowkar, Z., Fattah, Z., Asl, Z. K., & Hamidi, S. A. (2022). Stress, Sleep Quality, and Academic Performance among Dental Students in Shiraz, Iran. International Journal of Dentistry, 2022, 1–7. https://doi.org/10.1155/2022/3781324
10. Landis, C.A. & Lent, M.J. (2006). News alert for mothers: Having children at home doesn't increase your risk for severe daytime sleepiness and fatigue. SLEEP, 29:738 740.
11. Maheshwari, G., & Shaukat, F. (2019). Impact of poor sleep quality on the academic performance of medical students. Cureus. https://doi.org/10.7759/cureus.4357
12. McDevitt, E. A., Rokem, A., Silver, M. A., & Mednick, S. C. (2013). Sex differences in sleep-dependent perceptual learning. Vision Research, 99, 172–179. https://doi.org/10.1016/j.visres.2013.10.009
13. Owens, J. A., & Weiss, M. R. (2017). Insufficient sleep-in adolescents: causes and consequences. Minerva pediatrica, 69(4), 326-336.
14. Silver, E. A. (2013). Foundations of cognitive theory and research for mathematics problem-solving instruction. In Cognitive science and mathematics education (pp. 33-60). Routledge.
15. Urrila, A. S., Artiges, E., Massicotte, J., Miranda, R., Vulser, H., Bézivin-Frere, P., Lapidaire, W., Lemaître, H., Penttilä, J., Conrod, P. J., Garavan, H., Martinot, M. P., Martinot, J., Banaschewski, T., Flor, H., Fauth-Bühler, M., Poutska, L., Nees, F., Grimmer, Y., . . . Paus, T. (2017). Sleep habits, academic performance, and the adolescent brain structure. Scientific Reports, 7(1). https://doi.org/10.1038/srep41678
16. Walker, M. P. (2009). The Role of Sleep in Cognition and Emotion. Annals of the New York Academy of Sciences, 1156(1), 168–197. https://doi.org/10.1111/j.17496632.2009.04416.x
17. Wheaton, A. G. (2016). Sleep duration and injury-related risk behaviors among high school students—United States, 2007–2013. MMWR. Morbidity and mortality weekly report, 65.