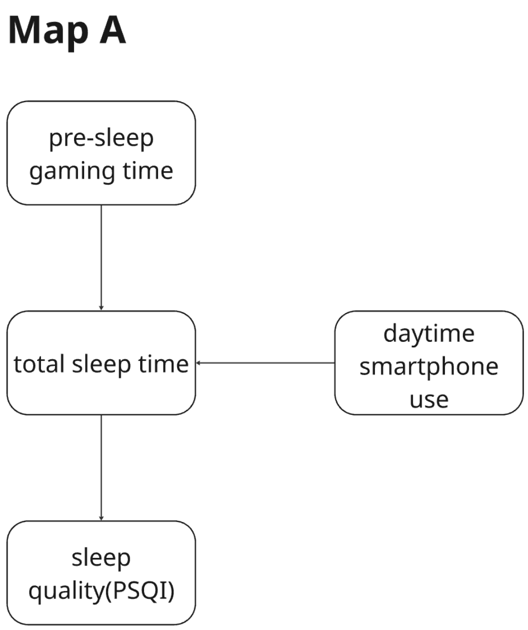
[Comparison Report]

Does Nighttime Gaming Affect Sleep Duration?

Group 12 – ACDT (Algorithmic, Computational & Data Thinking)

1. Map A - statistical significance based system map(empirical regression model)



This section tests the measurable link between pre-sleep gaming time and sleep outcomes. Following our updated analysis, we use total sleep time (minutes) as the primary dependent variable, and PSQI sleep quality as a secondary check. We also compare usage by time of day (daytime, pre-bed, post-bed).

The main research question was: Does playing games before sleep reduce total sleep time or worsen sleep quality?

Our variables were:

- Dependent variable (main): Total sleep time measured in minutes, calculated from each participant's bedtime and wake-up time.
- Dependent variable (secondary): Sleep quality based on the Pittsburgh Sleep Quality Index (PSQI) score, which ranges from 1 to 7.
- Independent variables: Time spent on gaming before sleep, usage of different types of applications (social media, video streaming, total smartphone use), and smartphone usage by time period (daytime, before bed, and after bed).

The dataset was cleaned by removing negative values, correcting unrealistic outliers, and fixing time errors around midnight to ensure reliable measurement.

Main findings are

- Simple Linear Regression: Pre-bed gaming → Total sleep time
  $\beta = -0.48$, $p = 0.605$, $R^2 = 0.002$ → not significant (no linear effect).

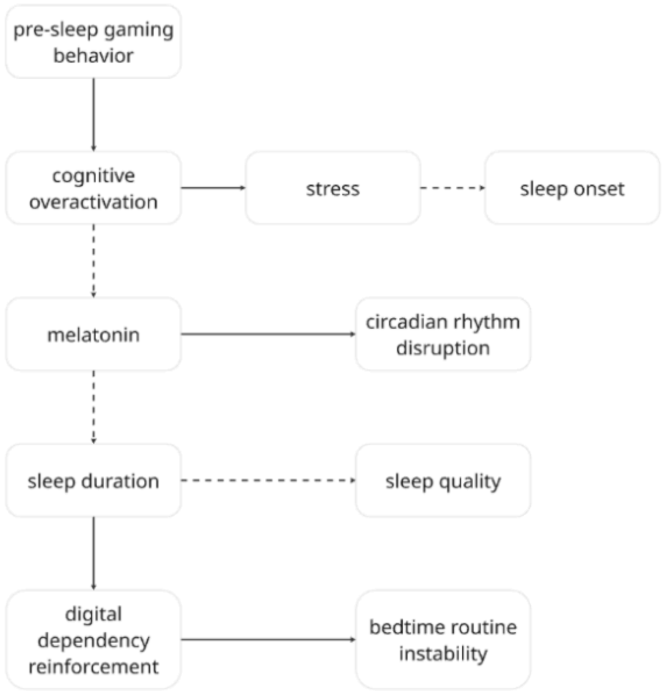
- Group Comparison (High vs Low Gamers, by median split)
  High = 528.6 min, Low = 520.6 min, $p = 0.419$ → no difference.

- Usage by Time of Day - Multiple Regression
  Daytime use: $\beta = -12.01$, $p = 0.009$ → significant negative effect.
  Pre-sleep use: $\beta = -0.23$, $p = 0.797$ → not significant.
  Post-bed use: $\beta = +12.07$, $p = 0.009$ → significant but direction unclear.
  → Daytime overuse is the main factor reducing sleep duration, not gaming before bed.

In summary, this system map shows that pre-sleep gaming time had no significant statistical effect on total sleep time ($\beta = -0.48$, $p = 0.605$, $R^2 = 0.002$). The regression line is nearly flat, meaning that longer gaming before bed does not clearly reduce sleep. However, daytime smartphone use showed a significant negative relationship with total sleep time ($\beta = -12.01$, $p = 0.009$), suggesting that daily digital rhythm, rather than bedtime gaming, has a stronger impact on sleep. Overall, Map A visualizes how data reveal no direct gaming effect but highlight the importance of balanced usage patterns across the day.

2. Map B

Map B



Map B shows that poor sleep is caused by digital rhythm imbalance — too much phone use during the day and night — rather than gaming itself.
Map B explains why gaming and smartphone use can still affect sleep, even when the numbers in Map A look weak. It uses ideas from psychology and biology to show the hidden reasons behind poor sleep. Playing games before bed makes the brain active and excited. This keeps the body from relaxing and falling asleep. At the same time, blue light from the screen blocks melatonin, a hormone that helps us sleep. When this happens many nights in a row, people start to depend on digital activity and their sleep rhythm becomes irregular. But our data show that when people use their phones matters more than what they do. Heavy daytime smartphone use ($\beta = -12.01$, $p = 0.009$) causes tiredness during the day, making people stay up later at night and sleep less overall.
This creates a repeating loop: Daytime fatigue → late-night gaming → shorter sleep → more fatigue → more nighttime use.
This feedback loop shows that sleep problems come from a cycle, not just one action. Hidden factors like stress, caffeine, and emotions also make the loop stronger. Even if these factors were not significant in Map A, they still help explain why some people's sleep is more disturbed than others'. In short, Map B shows that the real cause of poor sleep is not gaming itself, but digital rhythm imbalance — using screens too much during the day and at night, breaking the body's natural rest rhythm.

3. Comparative interpretation and implications

Map A shows that in this dataset, **pre-sleep gaming time did not significantly reduce total sleep time or quality** ($p > 0.05$).

However, Map B explains *why digital habits can still affect sleep* — through psychological and biological processes that a simple regression model cannot capture.

If we looked only at Map A, we might think gaming before bed has no real effect. But Map B reveals that **daily overuse and digital rhythm imbalance** — such as excessive daytime smartphone use, stress, and blue-light exposure — can lead to tiredness, late-night activity, and long-term sleep disruption.
This suggests that the problem is not one action (gaming) but a repeating cycle of fatigue and irregular sleep.

To improve sleep hygiene, these findings suggest that:

- Students should limit both daytime and nighttime smartphone use to keep a stable rhythm.

- Reducing blue-light exposure and using night mode can support faster sleep onset.

- Managing stress, caffeine, and emotional stimulation may be just as important as reducing screen time.

Together, Map A and Map B show two sides of the same issue:

- **Map A** gives measurable but weak short-term results.

- **Map B** provides a deeper theoretical explanation, showing how digital rhythm imbalance creates an ongoing feedback loop that reduces sleep over time.

This comparison shows how data and theory together create a more complete understanding of digital behavior — not only *what* happens, but *why* it happens.

For future studies, using wearable trackers or long-term measurements could help move from simple correlation to real causation, improving accuracy and identifying hidden variables like stress and emotional regulation.

In conclusion, Map A shows that gaming alone does not directly reduce sleep time, while Map B explains that accumulated fatigue and daily rhythm imbalance are the real reasons behind poor sleep.
Together, they suggest that better digital habits — rather than single restrictions — are key to improving sleep health.

4. Justification document
    - In Map A, only daytime smartphone use showed a statistically significant effect on total sleep time.
      However, variables such as stress level, caffeine intake, emotional arousal, and academic pressure can still affect sleep indirectly.

From the theoretical model in Map B, these non-significant factors act as hidden mediators that connect digital behavior and sleep outcomes.

For example, stress increases cognitive activity, making it difficult to fall asleep; caffeine delays melatonin release; emotional stimulation from games raises alertness; and academic workload adds fatigue.
Even though these variables are not statistically significant, they combine to create digital rhythm imbalance — disrupting the body's natural sleep cycle.
Recognizing their indirect influence helps avoid an overly simple conclusion like “gaming has no effect.”
Together, small but interacting variables explain the complex causes of poor sleep that cannot be captured by a single regression model.

- Ignoring hidden variables can lead to shallow advice like “Just play less before bed.”
  A better strategy is a multi-dimensional Digital Rhythm Management plan that considers both when and how people use their devices. For instance, using night mode or limiting blue light exposure can restore melatonin balance;
  setting digital curfews can reduce emotional stimulation;
  and limiting caffeine or managing stress can improve overall sleep health.
  By combining significant factors (like daytime use) with non-significant but meaningful ones (like stress and caffeine),
  policies can move beyond surface-level control to deeper digital wellbeing design. Future programs or studies can apply this framework to design personalized sleep improvement strategies,
  considering not only screen time but also emotional and environmental context.