Study on Sleep Quality of Students in Regards with Cognitive Capabilities and Academic Achievement Post COVID-19 Pandemic

Caecilia Sri Wahyuning1,*, Fitrah Tri Ramadhani2, Dinda Syifa Rahmani3, Antonius Tyaswidyono Moerti4

1234Industrial Engineering, Insititut Teknologi Nasional, Bandung – Indonesia

Abstract. A shift in lifestyle during COVID-19 pandemic affects daily conditions, including sleep condition. During pandemic, humans have plenty of time to rest by the virtue of eliminating commuting time for daily activities, therefore changing the sleeping pattern in society, including for students. Students from academic year 2020 are the first to experience online classes, but since Semester 1 of 2022/2023 academic year ITENAS are going back to normal, on-site class activities. This condition reverted the lifestyle shaped over the past two years, affecting cognitive function because one of the supporting factors of cognitive function is sleep quality. Data from ITENAS Academic Bureau showed 48% of students from 2020 suffered decline in GPA index during the first semester of 2022/2023 academic period. In this research the sleep quality of students will be studied using Pittsburgh Sleep Quality Index (PSQI), while cognitive capabilities will be observed through Cognitive Failure Questionnaire (CFQ) with special attention for student’s GPA index. From 97 students sampled for this research, there is an increase of students having bad sleeping quality at the start, during, and at the end of semester, with average percentage during all 3 periods at 89.69% of students with bad sleep quality. The number of students with high cognitive capabilities is increasing from the start, during, and after the end of semester, therefore there is no correlation between sleep quality and cognitive capabilities (p>0.05), as well as between sleep quality and academic achievement and between cognitive capabilities and academic achievement. Despite differences in sleep quality between students from Faculty of Industrial Engineering, Faculty of Civil Engineering and Planning, and Faculty of Architecture and Design, no apparent differences in cognitive capabilities and academic achievements to be observed.

1 Introduction

*Corresponding author: caecil@itenas.ac.id

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).
This study stems from the academic activities held during New Normal era post COVID-19 pandemic. During the pandemic, academic activities have been done online, therefore students from 2020 are now getting used with online classes. Institut Teknologi Nasional Bandung restarted on-site classes since Semester I 2022/23, therefore students from academic year 2020, 4 semesters into their studies having adapted with online classes, now will have to adapt with on-site classes. This means students need to readapt with normal work hours. 2 years with pandemic, there has been a major change in human lifestyle, including behaviors for human interaction using communication technology. Sleep pattern is one of the lifestyle parameters affected, with night sleep time decreases and is linked with depression, affecting sleep qualities in negative way[1], [2]. In fact, research involving 1225 research from 9 countries reports a 34% overall prevalence of depression on students during COVID-19 pandemic [2]. Meanwhile, internet addiction is found to have significant link with sleep deprivation. On the other hand, low sleep quality is linked with cognitive failure related with memory lapses and errors, to name a few [3]. Sleep-awake process affects momentary decline on cognitive function, as cognitive function is a function of time and is linked with sleep problems [4]. Good sleep quality increases cognitive function, protecting it against the decline [5]. A decline in cognitive performance, potentially causing accidents, has been attributed as an effect of sleep deprivation [6]. The majority of processes dealt with by students in campus involves mental processes. The information processing capacity of humans can be observed from the rate of cognitive failure as an indicator affecting work performance. For students, this comes in the shape of GPA index. This research is necessary since GPA index is a performance indicator for student's achievement in learning, becoming a measure of success in learning process. GPA index also indicates the performance of departments and institutions in accreditation assessment. Therefore, this research studied sleep quality of students from 2020, which already experienced 4 semesters of online classes, and how it affects cognitive failure and academic performance.

2 Methodology

This is quantitative research measuring sleep quality and cognitive performance using questionnaire as a research instrument. Instruments used in this research are Pittsburgh Sleep Quality Index (PSQI) to understand sleep quality and Cognitive Failures Questionnaire (CFQ) to assess cognitive performance.

2.1 Participant

Samples for this research included active students from ITENAS from academic year 2020 taking at least 20 credits with purposive sampling method. Based on Bernoulli formula with accuracy (α) of 5% and 95% degree of confidence, 97 respondents were required as sample. Using proportional random sampling, 34 individuals were picked from Faculty of Industrial Engineering, 25 from Faculty of Civil Engineering and Planning, and 38 from Faculty of Architecture and Design.

2.2 Pittsburgh Sleep Quality Index

Sleep is an important and crucial human function [7]. Good sleep quality positively affects physical and mental condition, formed by several factors. Sleep qualities were assessed using Pittsburgh Sleep Quality Index (PSQI), a questionnaire used to assess sleep quality and disturbance during a 1-month interval. 19 individual items resulted in 7 score ‘components’: Subjective quality, latency, duration, behavior efficiency, disturbance, usage
of medication, and daytime dysfunction. The sum of scores from all 7 components resulted in 1 global score. Value of PSQI ranges from 0 to 21, with higher numbers corresponding with lower sleep quality [8].

2.3 Cognitive Failures Questionnaire

Cognitive is a mental process involving cognition to illustrate how brain processes perceived information [9]. This research utilized Cognitive Failures Questionnaire (CFQ) to assess cognitive condition of students. This questionnaire was composed from 25 possible failure, collected from occurring daily events, to discover episodes that will be accepted by majority of people as something that occurred occasionally [10]. These questions were derived from 4 factors: memory, distractibility, blunder, and memory of names, with CFQ score ranging from 0 to 100. Higher CFQ scores relates to higher cognitive failure possibility [11]. Criteria for failure level is divided into 3 parts with ‘low’ criteria at <35% of total score, ‘medium’ at between 31-59%, and ‘high’ at >60%.

2.4 Research Design

Research was done for 1 semester, during semester 2 of academic year 2022/23. Each respondent filled out PSQI and CFQ at the start, in the middle, and at the end of semester. In addition, researchers gathered performance data of the students from previous semesters and academic achievement on the ongoing semester.

2.5 Statistical Analysis

Statistical analysis to test correlation of both variables utilized Kruskal-Wallis’s test, Chi-Square test and Spearman’s Correlation Analysis. The data obtained was evaluated in IBM SPSS (version 23.0) statistical package program.

3 Result and Discussion

3.1 Pittsburgh Sleep Quality Index (PSQI)

Result of Sleep Quality of Itenas Students Class of 2020 Based on 3 Measurement Periods can be seen on Table 1. At the start of semester only 12% of students had good sleep quality, with the number decreased in the middle and at the end of semester. This showed an increase of lower sleep quality within students as the semester rolls on.

| Sleep Quality | Measurement periods | | | | |
|---|---|---|---|---|
| | Pre | Middle | Post | |
| Good | 12 | 10 | 8 | |
| Poor | 85 | 87 | 89 | |
| Total | 97 | 97 | 97 | |
Low sleep quality dominates all through the semester for each faculty. Most participants have an age range between 20 to 21 years old with enthusiasm for social activities. Based on hobbies and activities outside of campus, most students all have packed schedules. Academic activities are demanding, and this is one of major stressors for students, with demands from academic life, such as high demands from teachers, overload of homework, and excessive weight on tests and exams, basically depletes student’s psychological reserve [12].

Differences in quality between all 3 faculties is shown on Figure 1. There are more low-quality sleep conditions for students of FAD and FCEP than those of FIT. This might be caused by the difference of learning method and characteristics between each faculty, where in FAD the learning process is dominated by works in studios, workshop, or computer labs.

![Sleep Quality Among Faculties](image)

**Figure. 1** Sleep Quality among Faculties

Based on the sleep quality components, global score contributing to sleep quality are subjective quality, latency, duration, and daytime dysfunction. At the start of semester 2 of the worst components were daytime dysfunction and duration with 40% of students suffered bad sleep duration (5-6 hours) and 60% suffered difficulties maintaining wakefulness during activities. Sleep duration increased as the semester went on but many still suffered bad sleep duration. For anxious individuals struggling to deal with daily stresses, sleep deprivation only serves to disturb their ability to control their stress [7]. At the start of the semester students are experiencing new subjects with new content or learning method, including new lecturers with new assistants with new characteristics. Therefore, students need to adapt to this new condition.

Daytime dysfunction of most students showed a decrease in the middle of semester (43.3%) but took a turn and increased during the end of semester (55.7%). Undergrad students has a night-type chronotype, affecting their daytime dysfunction scores [5]. There is an indication that the tendency for students of becoming active during the night changes their chronotype, which is an individual characteristic that determines the capacity of becoming more active and alert for several time range during the day [5]. We observe that at the start of semester more than 40% of students had a bad latency, showing that students required a lot of time to go to sleep. Behaviors during pandemic cause students to hang their lives on to their gadgets to interact through social network sites [3]. Blue light exposure before sleep affects the delay in circadian rhythm and suppresses melatonin, delaying sleep time which therefore affects circadian rhythm [13].
3.2 **Cognitive Failure Questionnaire (CFQ)**

Results of cognitive performance measurement can be seen on Table 2. The result showed that at the start of semester most students had a medium level of failure, and the numbers of high failure level increased by the middle and at the end of semester. Of all four CFQ factors, the highest contributing variable for high failure level is distractibility. This showed that most students tend to be easily distracted during daily activities. Ease of distraction shows that students had hard times concentrating, affecting learning process [14].

<table>
<thead>
<tr>
<th>Cognitive Capabilities</th>
<th>Beginning of The Semester</th>
<th>Middle of The Semester</th>
<th>End of The Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
</tr>
<tr>
<td>Low</td>
<td>12 12.4%</td>
<td>2 2.1%</td>
<td>1 1%</td>
</tr>
<tr>
<td>Medium</td>
<td>64 66%</td>
<td>54 55.7%</td>
<td>40 41.2%</td>
</tr>
<tr>
<td>High</td>
<td>21 21.6%</td>
<td>41 42.3%</td>
<td>56 57.7%</td>
</tr>
<tr>
<td>Total</td>
<td>97 100%</td>
<td>97 100%</td>
<td>97 100%</td>
</tr>
</tbody>
</table>

### Table 2. Cognitive Capabilities Based on 3 Measurement Periods.

3.3 **Correlation Sleep Quality and Cognitive Capabilities**

The study results show 90% of students suffered bad sleep quality from the start to the end of semester, with increased levels of cognitive failure as the semester went on. However, results from correlative statistic test between sleep quality and cognitive failure showed significance value of > 0.05 (p=0.525), which implies no correlation between sleep quality and cognitive failure on ITENAS students from Class 2020. This shows that decline in cognitive performance for students from Class 2020 is not caused by sleep quality.

Decline in attention increases difficulties in finishing tasks, with one of the factors is fatigue (including subjective fatigue). On the other hand, the increase of subjective fatigue is the effect of sleep limitation. However, fatigue is also affected by external factors like nutrition, postures, environment conditions, mood, expectations, and workload [15]. With increasing load, it is expected that fatigue also increases by the end of semester. With 2 years of online class, student mobilities significantly increased as offline class returns. This reduces time available for students between classes, since they are now required to move between classes, as well as doing round trips to and from campus.

There is no change in workload, but there are new demands during classes. New academic and social environment, overuse of social media sites and unhealthy lifestyle are several factors affecting sleep quality on students [5]. Regarding this, statistic test showed significance value of < 0.05 (p = 0.036), showing correlation between sleep quality and distractibility as a factor contributing to bad CFQ scores. Therefore, sleep duration and daytime dysfunction highly affects distractibility during classes.

3.4 **Correlation Sleep Quality, Cognitive Failure and Academic Performance**
This research also observes GPA of students. This is required to observe the decline or increase in academic performance. A 52% decrease in GPA happened during semester 2 of 2022/23. However, statistic test resulted in chi-square value of 0.01 < 3.841 (from chi square table), showing differences between GPAs of FIT, FCEP, and FAD students.

In regards with sleep quality, test result showed chi-square value of $p = 0.979$ ($p > 0.05$), showing no correlation between sleep quality and academic performance in ITENAS students from Class 2020 with significance $> 0.05$. Several research showed that academic performance is affected by sleep time, not total time spent in bed [5], meanwhile for ITENAS students these contributing factors are durations, daytime dysfunction, and sleep latency. Based on cognitive failure, test showed $p > 0.05$, showing no correlation between cognitive failure and academic performance both at the start ($p = 0.927$) and the end of semester ($p = 0.194$). Several research showed that General Cognitive Ability (GCA) is a reliable predictor for academic performance.

However, outside of sleep adequacy, academic performance is also affected by nutrition [16], resilience of students, learning environments[17], academic stresses, anxiety, and depression [18]. Therefore, this decline in performance on ITENAS students can also be attributed to aforementioned factors.

Based on the discussion above, there needs to be future research to study what factors affect this performance decline. Self-regulated learning enables student to control and monitor their learning process [19], improving cognition, affection, and behavior of students, including organizing their activities. Practices, monitoring, time management and improvement in positive learning environment will help to improve students’ active involvement in the process of learning [20].

In relation to cognitive function, high CFQ indicates high distractibility. Studies showed that the root cause for these are mental and physical fatigue, caused by reactivity towards new environments and is linked to psychological pressure caused by imbalance of demand and resource. Stress is a negative emotional experience, followed by changes in cognitive performance and behavior, being a consequence of stress (strain). One way to reduce stress-strain relation is with social support [21] which correlates with sleep recovery. Positive socio-psychological indicator reduces neurohormonal change, positively contributing towards better sleep quality[12]. Social support refers to care and support for individuals, perception/experience of individuals in regards of care, attention, value, feeling of acceptance or help from others[12], [22]. This can be conceptualized as emotional support in relation with others [22]. Therefore, social support can be obtained through family or activities outside classes on campus. Academic institution needs to offer help for students in stress management, emotional control, improvement in life quality and social support to prevent or mitigate depression in the future [12].

4 Conclusion

This research shows no correlation between sleep quality (PSQI scores) with cognitive performance (CFQ scores) of Itenas students from Class 2020 after 4 semesters of online classes. However, most students showed bad sleep quality and cognitive failure, which increased through the second semester of 2022/23. There is no correlation between PSQI and CFQ scores towards student’s GPAs, therefore performance decline is not directly affected by sleep quality and cognitive performance.

There is also an indication of shifts towards evening type from morning type in students, as the effect of behavior shift during pandemic. We hope that in two semesters going on students can re-adapt with morning behavior to reduce sleeping problems, therefore increasing motivation. In addition, there needs to be future studies analyzing academic stressors that affect academic performance to improve students’ motivation in.
We expect this research to be followed by further studies to help students with their academic performance.

This work has been financially supported by the Faculty of Industrial Technology (Grant No. 3188/N.008/FTI/ITenas/VII/2023), Institut Teknologi Nasional Bandung, Indonesia. A high appreciation to the faculty members for their support in this project.

REFERENCES

3. N. Xanidis, C. M. Brignell. "The association between the use of social network sites, sleep quality and cognitive function during the day." Computers in human behavior 55, 121-126, (2016)