

A Correlative Analysis between Circadian Rhythm and Gender with Academic Performance among Medical Technology Students (AY 2020-2021)

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Abstract: - The alertness and productivity of an individual within the day or night, known as the circadian rhythm, can affect his or her academic performance. The CoViD-19 pandemic has generated online learning to be possible nowadays. Given the current situation, the study aims to determine the relationship between circadian rhythm and gender with academic achievement among Medical Technology students of a Philippine university during the initiation of the online learning set-up. 360 students who were currently enrolled in the Medical Technology program of this university participated in the study. The demographic information and academic standings of the participants were gathered to build a foundation on their background and scholastic profile. The Morningness-Eveningness Questionnaire (MEQ) modified by Sarah Briggs (2015) was used to assess their circadian rhythm and academic performance. Data analysis was performed using the Fisher Freeman Halton Exact Test to assess the degree of independence among the variables. After the results were obtained, the researchers observed that the p-values of the relationships of the variables, specifically between circadian rhythm and gender ($p = 0.210$), circadian rhythm and academic performance ($p = 0.616$), and gender and academic performance ($p = 0.122$) were higher than the significant p-value ($\alpha = 0.05$). This indicated that there was insufficient evidence to infer that there is a significant relationship among these variables. Thus, it implies that there is no significant correlation existing between circadian rhythm and gender with academic performance of the Medical Technology students. These findings can be helpful by letting students acknowledge ways, based on other factors, which can improve one's academic performance in spite of his or her circadian rhythm.

Key Words: — *Circadian rhythm, gender, academic performance, Medical Technology, students, online learning, CoViD-19.*

I. BACKGROUND OF THE STUDY

A. Introduction

Determining a morning-evening person is a widely tackled property in human circadian functioning (Jankowski, 2014). An individual's circadian rhythm - chronotype - differs between the activity and alertness of oneself between day and night. (Lindberg, 2020) To differentiate the two, Horne and Östberg

(1976) called these early risers as "morning types" while late risers as "evening types." Morning types are those who prefer working and studying in the morning as they are mentally and physically active until they become exhausted in the evening. Meanwhile, the evening types who are considered as "owls," are active in the late afternoon or at night. Academic Performance relies on intelligence, personal traits along (Aluja-Fabregat & Blanch, 2004; Laidra et al., 2007; Lounsbury et al., 2003) with the learning strategies (Putnam et al., 2016). Multiple studies stated that the performance of a student in academics is related to their sleeping habits and schedule of their classes (Wolfson & Carskadon, 2003). In congruence with, recent studies have shown that morning types perform

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better than the evening types based on learning evaluations (Preckel et al., 2011; Kolomeichuk et al., 2016; Akram et al., 2018) A previous study conducted in Sudan (Mirghani, 2017), showed that average-grade medical students displayed more of an evening person than those of the excellent-grade medical students. These medical students adopted a morning schedule. However, there are other studies showing that due to schedule misalignment, morning types had slept worse during night shifts along with evening types with morning shifts (Roenneberg, Allebrandt, Meroow & Vetter, 2012)

Gender is a characteristic that may be put into consideration in determining an individual's circadian characteristics (Anderson & Fitzgerald, 2020). A study states that women are known to be more of the morning types as they have an advanced sleeping schedule and an early circadian phase than men (Vink, Groot, Kerkhof, Boomsma, 2001). Another study reported that at the age of 30, women are more of a morning type than the men until no significant differences were shown at the age of 45 (Lombardi, D. & Wellman, H. & Roenneberg, T., 2017). Even so, some studies claim no significant differences between the two (Greenwood, 1994). Hence, age-dependent and gender-dependent changes in chronotype may be determined by its biological factors. With the relationship between chronotype and gender already being analyzed, there have also been studies analyzing the correlation between its relationship and academic performance. Researchers found that females that are morning types can score higher than males, this study was conducted on medical students of Tabuk City in Saudi Arabia (Alnomsi et al., 2018).

Academic performance was discussed to be affected by numerous factors and this includes the environment the student is in and different external factors, such as the current situation of a pandemic, can influence an individual's circadian rhythm and academic performance. The worldwide pandemic has caused the disabling of all individuals to adjust to the new normal and this includes alternative learning. Home-based alternative learning modality or "flexible learning" is the alternative and modified way to face-to-face classes that allows students to learn in the current pandemic. A study conducted on students in India looked at the perspective of students and professors regarding this type of flexible learning that has the same objectives as all the universities in Asia (Dhawan, 2020). Certain changes are needed in the curriculum and way of teaching that make it more challenging for both the students and the teachers. The University of Santo Tomas is one of the schools that has already implemented this new system, and this

includes the focus of the researchers' study, who are the students enrolled under the Medical Technology program from the Faculty of Pharmacy.

The Bachelor of Science in Medical Technology is a three-year academic program with a one-year internship consisting of general, professional, and competent courses. With the current situation of the pandemic, online classes are being held for the Medical Technology students and teachers alike to continue delivering education to the students. Given these observed changes, the researchers have made it an aim to identify if the mentioned variables could affect the academic performance of these students considering the current situation in the Philippines.

There have been different studies that tackled the correlation of circadian rhythm and gender with the academic performance of people. However, none of these studies have addressed the importance of this correlation in the aspect of the current situation. In addition to that, this topic has not been tackled in the Philippines nor studied among the first to fourth-year Medical Technology students as the sample population.

Therefore, by addressing the correlation between the said variables, it may provide an aid to the students who are currently struggling with their academic performance while in an online learning set-up. Hence, the researchers have conducted the study to determine the correlation between the circadian rhythm and the gender to the academic performance to suggest a schedule system towards providing students a flexible learning environment considering the pandemic.

B. Objectives of the Study

General Objective:

This study determined the relationship of circadian rhythm and gender of an individual with the academic achievement of Medical Technology students of the University of Santo Tomas. It evaluated the correlation between circadian rhythm and gender as predictors of academic achievement and how these variables affect the general weighted average of the medical technology students.

Specific Objectives:

To attain the purpose of this study, the researchers would be able to do the following by the end of this study:

- Determine the relationship between the circadian rhythm of an individual and gender
- Establish the relationship of gender with academic performance of Medical Technology students

- Correlate circadian rhythm with the academic performance of the Medical Technology students

C. Statement of the Problem

General Problem:

What is the correlation between circadian rhythm and gender as predictors of academic achievement and how these variables affect the general weighted average of the medical technology students?

Specific Problems:

The study specifically serves to answer the following questions:

- Is there a significant relationship between a person's circadian rhythm and gender?
- Is there a significant relationship between circadian rhythm and academic performance?
- Is there a significant relationship between gender and academic performance?

D. Hypothesis of the Study

To meet the objectives of this research, the following hypotheses were used:

H_0 : The academic performance among Medical Technology students from the University Of Santo Tomas AY 2020-2021 does not correlate with their circadian rhythm and gender.

H_a : The academic performance among Medical Technology students from the University of Santo Tomas AY 2020-2021 does correlate with their circadian rhythm and gender.

E. Scope and Limitations of the Study

The scope of the study included the analysis of the correlation between circadian rhythm and gender with the academic performance of Medical Technology students. The study aims to elucidate the effects of the above-mentioned variables on the academic performance of the participants to formulate recommendations that can help set forth an effective strategy to maximize productivity according to a person's specific chronotype. The study was quantitative and took the course of 1st semester of Academic Year 2020 - 2021. The researchers utilized existing tools from other related literature to assess the factors required to correlate the variables as well as validate the accuracy, consistency, and reliability of the findings in the study.

The study has potential limitations. It is only limited to BS Medical Technology students currently enrolled during the AY 2020 - 2021 from the University of Santo Tomas undergoing

new home-based alternative learning. It did not gather information from Medical Technology students from other universities.

The researchers have not considered, as well, the different course subjects of each year level, which may account for some of the discrepancies in the academic achievements. This study also restricted its scope to the circadian rhythm and gender. On the other hand, factors that may affect academic achievements such as environment, ambiance, socioeconomic status, availability of gadgets, number of units and internet connection were not included in the analysis.

F. Significance of the Study

The generalization of this study would be a great contribution in this field of study, as the researchers will partake in the correlation of chronotype to the gender and academic achievement of students. Vital results of this investigation could be highly significant and beneficial specifically to the following:

To the School Administration:

This study will provide information to the school administrations regarding the possible outcome of the correlation of gender and circadian rhythm on the academic performance of the students. The results can serve as a basis for the necessary interventions that may help the students to learn more effectively.

To the Students:

This study will let the students gain insights on any improvements or adjustments that are suggested to attain the right amount of sleeping hours while still being able to work effectively and actively. Additionally, the students will be aware of how to manage their time wisely according to their gender in a scientific approach.

To the Parents:

With parents as the first on-hand to be wary of their children's situation, these results will also benefit them in understanding their child's health more by reminding them to take care of one's health and deciding priorities.

To the Future Researchers:

This study will help future researchers uncover critical areas in the educational process and variables that many researchers were not able to explore.

G. Definition of Terms

Academic achievement: The accomplishment of medium or long-term objectives of education.

Academic performance: The observable and measurable behavior of a student in a particular situation.

Androgen and Testosterone: Male sex hormones.

Asynchronous learning: A form of learning that occurs at different places and different times.

Bachelor of Science in Medical Technology: A four-year program consisting of general education and professional courses focused on the application of laboratory science to aid the physician in the diagnosis of diseases.

Blackboard: An online system that facilitates online learning through specialized functions.

Brain lateralization: A functional dominance of one hemisphere of the brain over the other that causes a tendency to develop neural functions or cognitive processes.

Chronotype: The internal circadian rhythm or body clock of an individual that influences the cycle of sleep and activity in a 24-hour period.

Circadian rhythm. Physical, mental, and behavioral changes that follow a daily cycle.

Dim Light Melatonin Onset. The time point when melatonin starts being produced in the evening under dim light conditions.

Procrastination. The act or habit of delaying a task that could have been done at an earlier time.

Scaffolding. A process through which a teacher expresses forms of support to students to aid in their learning.

Shifting period. One fraction of a semester that is divided into three parts.

Social determinism. A theory that individual behavior is determined by social interactions and constructs.

Synchronous learning. A form of remote learning that occurs at the same time.

Test anxiety. A subjective experience of various physical symptoms and emotional reactions prior to or while taking a test.

Visual pursuit. A visual processing skill that allows perception and retrieval of visual information.

II. LITERATURE

A. Review of Related Literature

This chapter presents the relevant and related literature that analyzes the hypotheses of this study and supports its objectives. After a thorough analysis of sources, the gathered information provided an understanding of how circadian rhythm and gender correlate with academic performance. The researchers also tackled the theory proposed for this study and explained the hypothesis of this study and how each variable relates to each other, depicting it through a conceptual diagram.

Academic Performance:

Academic performance became a vital role in determining proper educational capability, playing a big part in the life of a student (Kell, Lubinski, & Benbow, 2013). Spinath (2012) defined academic performance as “level of intellectual education of a person, a group, or a whole nation”. It can be observed in two different areas: first, in the intellectual field, excluding sports and music and second, in educational institutions such as schools and universities. According to many studies, to perform well means to be able to rely on one’s own intellect, personal traits (Aluja-Fabregat & Blanch, 2004; Laidra et al., 2007; Lounsbury et al., 2003) and learning strategies (Putnam et al., 2016). Academic achievement became one of the factors along with attention, approaches in thinking, visual pursuit, cognitive impairment and intellect that significantly influenced the chronotype or circadian preferences of an individual (Matchock & Mordkoff, 2009; Fabbri et al., 2007; Natale et al., 2003; Mecacci et al, 2004; Goldstein et al., 2007; Beşoluk, 2011; Digdon & Howell, 2008; Hess et al., 2000; Randler & Frech, 2006, 2009). This study considered two factors that affect the individual’s academic achievement: Circadian Rhythm and Gender Differences.

Another factor to be considered in the study is the general differences of a person according to his or her academic performance. Sex or gender became essential in undertaking human behaviors and growth. It delivered an impact on having an efficient study habit which supports progress in their education. It can also be reported that an individual that looks at oneself is important in maintaining an effective study proficiency (Alzahrani, S., Park, Y.S. & Tekian, A., 2018). Findings on gender differences in study habits became significant in explaining differences between one study to another. Studies showed that males and females were distinctly based on their “reading attitudes” and “measures of motivation”, wherein females leaned on becoming very active readers, demonstrating reading by depicting self-concept, and

they were more engaged in reading activities (Mullis, Martin, Gonzalez, & Kennedy, 2003; Meece, Glienke, & Burg, 2006). The disparities that were shown cited the validation of results, explaining that females achieved a higher reading achievement rate than males. This discovery served as supported evidence that gender differences were a factor in determining a student's performance. A study conducted by Dayioglu and Turut-Asik (2004) named "Gender Differences in Academic Performance in a Large Public University in Turkey" interpreted a wide gender discrepancy between the public life and its patriarchal social structure, leading to lower academic performance for female students.

In one of the studies involving a debate on biological determinism against the social aspect, Lynn (2004) has emphasized that males, having a bigger average brain size than females, are expected to have greater Intelligent Quotients, however, there were pieces of evidence that appeared to be the opposite. A study conducted by Arash Rahafar and his colleagues (2015) about the role of chronotype, gender, test anxiety, and conscientiousness in the academic achievement of high school students illustrated evidence from acquiring the students' Grade Point Average (GPA) from the school authorities. From their results, it revealed that gender differences were a strong predictor of attaining a high academic achievement as females having higher grades with higher test anxiety than males. This evidence of females achieving higher has also been seen from Freudenthaler and his colleagues (2008) along with the distinction of intelligence becoming the strongest predictor of academic achievement (Steinmayr & Spinath, 2008). A study in East Karelia (Kolomeichuk, Randler, Shabalina, Fradkova & Borisenkov, 2016) also showed evidence that is "worth noting" wherein greater academic achievement has been witnessed on females rather than males.

The various studies demonstrated a controversy of gender differences as a strong predictor of attaining academic achievement. Despite the debatable evidence on determining higher academic achievement, there were also researches inferring that gender differences and academic achievement have no significant differences between the attainment of mean scores among female and male students in experimental and control groups (Rhadeem, 2012). A weak positive relationship on gender and academic achievement was observed among medical undergraduates, suggesting that there is no significant relationship between them (Mushtak & Khan, 2012). Furthermore, there may be a difference between cognitive-motivational function among males and females, and

it was suggested to include other variables such as perception on taking classes, their teachers, and the type of treatment they receive which may influence their academic performance (Ghazvini & Khajehpour, 2011).

Another factor to be taken into account in relation to academic performance is the circadian rhythm. Circadian rhythm is also known as morningness/eveningness. It was defined as one's daily preference, and attentiveness during the day or night (Pagel, 2009). An individual's cognitive and body function are different all throughout the day because of circadian rhythm. It may be influenced by environmental factors that give impact to its "timing, expression of sleep, and wakefulness." Sleep is a factor that can be affected by various factors such as the usage of the internet, social media, medications, and caffeine intake (Mirghani, Mohammed, Almutadha & Ahmed, 2015). It may also be modified through varied medical conditions which showed a negative association with the well-being and academic achievement of students.

To illustrate an understanding about circadian rhythm, persons who tend to become very active during the day – physically and mentally – are also known as Larks for those with a morning chronotype. On the other hand, their counterpart is called Night Owls for individuals with an evening chronotype. They performed their best performance during the night. These two preferences were presumed to contain genetic, biological, psychosocial, and contextual components (Robert, Timea & Adrien, 2011). They have been linked to different behaviors like eating habits, sleeping behavior among students, use of drug substances, and smoking. It has been linked that morning persons are correlated with physical and mental health, performance in school, intimacy, and self-esteem while evening persons are correlated with smoking, deprived sleep quality, mental illness, and diseases (Barbosa, Velez, Pepper, Andrade, Gelaye, Yanez & Williams, 2014).

A factor that reduces attention and increases school-related problems among students is getting insufficient sleep (Fallone, Acebo, Seifer, & Carskadon, 2005). This is similar to daytime sleepiness wherein evening persons suffer between the two chronotypes ((Russo, Bruni, Lucidi, Ferri, & Violani, 2007). This gives an impact on the characteristic that academic achievement may also be affected by the Morningness-Eveningness of a person (Giannotti, Cortesi, Sebastiani, & Ottaviano, 2002).

A study conducted by Randler and Frech (2006;2009) explained that those that were able to perform better were the morning chronotypes while evening chronotypes, on the other

hand, had received poor results. Aside from getting lower performance, they were also assumed to be associated with school-related problems and family conflicts (Vollmer, Schaal, Hummel, & Randler, 2011). Similar studies showed that those that displayed high academic performance were seen for morning persons (Mirghani, 2017; Short, Gradisar, Lack & Wright, 2013), however, it was also suggested that chronotype may not be directly influenced on performance, rather mediated by daytime sleepiness and learning motivation (Roeser, Schlarb & Kubler, 2012). Furthermore, to improve an individual's performance and daytime alertness, sleeping strategies and adaptive circadian body clock may be adapted (Gradisar, Lack & Wright, 2013)

Other factors that continue to influence the circadian rhythm of an individual are the following: academic achievement, attention, visual pursuit, cognitive impairment, approaches in thinking, and gender differences as aforementioned. However, this study will focus on two major variables for this study: gender and circadian rhythm, as these affect a student's learning style and performance.

Gender:

In correlation with the said points in factors affecting the academic performance of individuals, gender is one factor that is studied and observed to have an influence on performance, as implied in studies indicating debates on what gender is smarter. Academic performance has piqued the interest of numerous research for its significant correlation with individual and social factors such as social wealth, vocational career success, and socioeconomic prosperity (Ruffing et al., 2015). In the past years, there has been a controversial debate on whether which, a male or a female, is the smarter gender especially due to the rise in the number of women joining the workforce in the past decade contrary to previous practices.

Multiple studies have attempted to determine the correlation between an individual's gender and their academic performance. However, choosing the appropriate method to be used has been a challenge. In their study, comparing how cognitive abilities vary among either gender entitled, *The Smarter Sex: A Critical Review of Sex Differences in Intelligence*, it was inferred that general intelligence cannot be attributed to a single gender just as the standardized IQ test has been modified not to include questions that would demonstrate gender differences. Instead, the questions were balanced by eliminating items that a greater proportion of a single gender would be able to answer correctly. Besides, the term

"intelligence" and what it is being measured for to assess its true nature remains ambiguous.

Currently, there are no studies proving that one gender excels in academic performance over the other. However, several existing studies have focused on factors that ultimately affect academic performance such as learning strategies, study habits, and productivity in males and females.

Learning behavior and general cognitive ability were both significant factors affecting academic achievement (Ruffing et al., 2015). Although general cognitive ability was not identified to have any gender difference (Halpern et al., 2011), learning behavior varied among the participants. Male students relied more on critical evaluation and relationships while female students applied learning strategies more frequently. This behavior may have indicated a more positive attitude toward academic studies. (Schiefele et al., 2003; Kesici et al., 2009; Virtanen and Nevgi, 2010; Marrs and Sigler, 2012). Furthermore, more frequent application of learning strategies, particularly effort and attention, is seen to be of greater importance to overall academic success compared to general cognitive ability alone (Credé and Kuncel, 2008).

Males demonstrated a greater advantage in several tasks that assess visual image manipulation in working memory while female's advantage was found in tasks that required long-term memory retrieval as well as the acquisition and use of verbal information. (Halpern and LaMay, 2000).

According to research, while female students attained higher grades in math (American Association of University Women Educational Foundation 2008; Voyer and Voyer, 2014), male students still outscored them on high stakes standardized assessments. However, on recent meta-analyses, it was established that these gender differences in math ability were insignificant with a small average effect size of $d < 0.15$ (Hyde et al. 2008; Lindberg et al. 2010).

To further discuss, different ability patterns were observed on opposite genders. Girls were found to have both high math and verbal ability while boys have a higher math ability compared to verbal ability (Wang et al. 2013). One meta-analysis also showed that males prefer working with objects, whereas females preferred working with other people (Su et al. 2009).

In addition to that, results in achievement tests demonstrated gender differences that coincided with stereotypical patterns yet, regardless of the material, females in general score higher on school marks (Voyer and Voyer, 2014).

Shafi and Loan (2010) stated that gender is a central point that affects reading habits. Males and females have distinctive reading inclination and aptitude. (Ameyaw & Anto, 2017) found in their study that females tend to have a more positive attitude for reading compared to males. Having positive attitudes towards reading, females tend to engage in reading even outside the school environment (Meece, Glienke, & Burg, 2006). According to the Canadian Council on Learning (2009), this gender attitude of males made them less frequent readers. Women remained to be underrepresented in numerous fields of Science, Technology, Engineering, and Mathematics despite accounting for nearly half (44%) of Ph.D. degree holders in life sciences (Wang and Degol, 2016).

Additionally, academic procrastination was also a factor that may affect students' academic performance significantly. A recent study entitled, Gender Differences in the Relationship between Academic Procrastination, Satisfaction with Academic Life and Academic Performance, stated that male students are more vulnerable to academic procrastination and its destructive effects, different from their female counterparts who were reported to have an advantage in academic performance and satisfaction due to lower level of procrastination. (Balkis, M., 2017)

Differences in absolute ability, strengths, and career and lifestyle preferences were possibly affected by biological roots. However, sociocultural factors were seen to have a greater impact on career choices of both genders. Biological components that were studied to influence gender behaviors are prenatal androgen exposure, testosterone exposure, and brain lateralization. Androgen exposure was found to have a degree of influence on the preferences of each gender (Wang and Degol, 2016). However, findings regarding the relationship between testosterone exposure and greater brain lateralization to higher mathematical reasoning and lower verbal ability in males turned out inconclusive (Miller and Halpern 2014; Valla and Ceci 2011). On the other hand, sociocultural factors encompassed societal beliefs and expectations of the abilities men and women should possess as well as differences in masculine and feminine roles and supposed interests (Wang and Degol, 2016).

Moreover, parents' and teachers' influence were also contributing factors in the biased assumption by underestimating math abilities in girls despite both genders attained similar grades (Bleeker and Jacobs 2004; Lubienski et al. 2013; Tiedemann 2000b), promoting math and science pursuits more often in boys than girls (Tenenbaum 2009), and

attributed boys' success in math to their ability and pointed at lack of effort for failures while implying the opposite for girls (Tiedemann 2000a). Meanwhile, higher verbal abilities related to girls may be partially attributed to their relationship and interaction with their parents from a young age such that open communication and supportive speech were used more towards daughters than sons (Leaper et al. 1998). More time was also spent by parents in teaching verbal abilities such as reading and storytelling to girls (Baker and Milligan 2013). The difference caused by these factors experienced at a young age may persist until later in life and influence individual abilities.

Another factor that may have contributed to overall academic performance is a person's sleeping pattern and quality which can be gender-specific to a certain degree. The prevalence of sleep disorders is different across the globe concerning gender. Female students were found to be more susceptible to insomnia than male students (Piro et al., 2017). Additionally, women were also more prone to stress and depression (Pedrelli et al., 2017) which contributed to lower quality of sleep that may consequently affect their academic performance as well (Linton, 2004).

Circadian Rhythm:

Academic performance can also be affected by one's circadian rhythm and this is supported by several studies. Chronotype or circadian rhythm is commonly called "morningness and eveningness". It specifically refers to the habits of a person whether he or she does more activities in the morning or in the evening, but individuals may lie in between, which can be referred to as the "neither" type. While a morning-type person is someone who gets up easily and is more alert in the morning than in the evening. Contrarily, an evening-type person is more alert at night, often sleeping late into the morning (Preckel, F. & Lipnevich, A. & Schneider, S. & Roberts, R., 2011). The biological rhythms of a person affect a person's lifestyle in many aspects and circadian rhythm was one of the most important of these rhythms in affecting learners' cognitive and school performance (Horzum, M. & Onder, I. & Kubler, A. (2013). Circadian rhythm may influence a variety of psychological and physiological functions such as psychological and physiological well-being, physical performance, cognition, school performances, and sleep (Adan et al., 2012; Escribano, Díaz-Morales, Delgado, & Collado, 2012; Prieto, Díaz-Morales, Escribano, Mateo, & Randler, 2012; Roeser, Brückner, Schwerdtle, Schlarb, & Kübler, 2012).

One of the functions that circadian rhythm can influence very significantly is academic performance. An individual's

preference for morning or evening activities, also known as chronotype, appears to be a good predictor of academic performance. Numerous publications arose on the association between different measures of academic achievements such as general weighted average (GWA) and other measures of chronotype (Preckel et al., 2011). The study of Preckel et al. (2011) was based on seven published journals concerning the relationship between academic achievement and morningness. These authors used the Lark-Owl Chronotype Indicator (LOCI) (Roberts, 1998) which is a conceptualization of circadian preference as a two-dimensional construct that considers morningness and eveningness as two relatively independent traits. The Lark-Owl Chronotype Indicator (LOCI) is one of the questionnaires used to measure circadian preference which pooled together the studies that explored such relationships in school pupils and university students. In that study, eveningness was negatively related with the indicators of academic performance ($r = 0.14$), while on the other side morningness was positively related with academic performance ($r = 0.16$).

The correlation between circadian rhythm and the cognitive ability of a person was discussed by Killgore and Killgore (2007) that revealed correlations between verbal cognitive ability and circadian rhythm, and the findings dictate that those individuals high in eveningness were more likely to do well on measures of memory, processing speed, and cognitive ability, even when those cognitive tasks were performed early in the morning, but the latter finding was true for female participants. On the other hand, with the study of Gomes, Tavares, and Azevedo (2002), the researchers' concluded that eveningness is associated with poor academic performance in relation to one's sleep-wake cycle, wherein evening persons may study well at night but it may result to lack of sleep and when classes are conducted in the morning, these people will not be alert and may not perform well during examinations since these are usually conducted in the morning.

Low motivation and alertness in the morning were a major disadvantage of an evening person especially when it comes to academics. Although, Evening types taking classes and exams in the evening might perform just as well as morning types taking classes and exams in the morning (Enright, T., & Refinetti, R. (2017)). On the other hand, morning persons have an advantage when it comes to academic performance because as said before, school usually starts in the morning which makes it better for students to be active and focused. Being a morning person might be associated not only with less sleepiness, but also with elevated motivation to learn, and functional attitudes

about achievement, resulting in stronger academic performance (Randler & Frech, 2006, 2009). The synchronicity between the circadian rhythm of students may be affected negatively (Escribano et al., 2012; Önder, Horzum, & Beşoluk, 2012). For example, when evening-type individuals must wake up earlier than their usual wake-up time, the resulting sleep debt has to be recovered during the weekend or free-school/workdays (Fabbian et al. 2016). This phenomenon has been defined as social jetlag (Wittman et al., 2006) and it is considered the underlying cause of disorders and comorbidities of the 21st century.

Morningness-eveningness preference of individuals may be changed according to age and gender (Díaz-Morales & Sorroche, 2008; Randler, 2007). Chronotype of adolescents was typically later than in all other age groups, which resulted in later sleeping times (Roenneberg et al., 2007a). College students were also associated with later sleeping times and higher cognitive activity at night because of the workload of universities, thus studies have shown that starting school early lead to chronic sleep deficiency in students (Carskadon et al., 1998; Gibson et al., 2006; Roberts et al., 2009), a phenomenon that was associated with lower academic performance (Wolfson and Carskadon, 2003; Meijer, 2008; Lo et al., 2012; Philip et al., 2012; Perez-Lloret et al., 2013). In this generation, technology is everywhere which made people do everything that they wanted and needed through their phones or computers all day until night affecting an individuals' sleep-wake cycle which made the evening type of individuals more common in this modern age. Other factors that can affect one's chronotype was the consumption of caffeinated drinks, which may increase the energy of evening persons in the morning, and physical activity or inactivity, which affected one's energy at any time of the day.

Online Learning:

As the years passed, technology continually developed to respond to the adversities and the growing needs of society. Many individuals conceptualized ideas and innovations important for different sectors of society such as medicine, education, business, or communication to enhance globalization. Its development led to the digitalization of society, wherein most methods and processes essential for life and work such as payment or information systems have become digitized to make life easier and convenient for many. This allowed the increased permeability of data towards different channels across technologies of individuals. One of the fields that were focused on for this study was education.

Online learning is the product of digitized education. It came as a form of distance learning, occupying the largest sector of this type (Bartley & Golek, 2004, Evans & Haase, 2001, as cited by Nguyen, 2015). Its development dated back to the 1990s, when the Internet was already thriving (Palvia et. al, 2018). To provide modules and learnings to students, online programs were commenced for universities, individuals from remote locations and for those who opt to eliminate travel time. However, these were discontinued, which led the educators to develop another method of learning called the blended or hybrid programs wherein both face-to-face classes and online learning were applied to enhance the education of students. Today, online learning has evolved into the application of advanced technologies to offer asynchronous and synchronous learning systems and real-time delivery options, alongside online instruments such as online discussion boards, chat rooms, and video conferencing media, as stated in the study of Shailendra Palvia et.al (2018) on online education and its worldwide status.

There were also factors that were essential in building up the effectiveness of an online learning environment. These can affect the academic performance of the student defined by their biological sex. According to a literature review analysis by Anne-Mette Nortvig, Anne Kristine Petersen, and Søren Hattesen Balle (2018), factors that influenced an online or virtual learning environment include educator presence in online settings, interactions between students, teachers, and content and designed connections between online and offline activities along with campus-related and practice-related activities. Another study by Emtinan Alqurashi (2019), wherein her study aimed to explore how online learning self-efficacy (OLSE), learner-content interaction (LCI), learner-instructor interaction (LII), and learner-learner interaction (LLI) can predict student satisfaction and perceived learning. The common factor found in these two studies was the interactions between students, teachers, and content, which will be the most focused factor among what was enumerated above.

In addition to that, interactions between the students and educators were also considered as a factor that enhanced the online learning system. According to their review of two studies, they found that these interactions among them were vital in achieving student satisfaction and successful learning outcomes. (Chiero et. al, 2015, Fedynich et al., 2015 as cited by Nortvig et. al, 2018). It was also indicated in their review of Choi's study on how people learned in an asynchronous online learning environment (2016) that peer-to-peer learning resulted

in student satisfaction. Interactions, therefore, encouraged a collaborative learning environment, wherein students were able to achieve the outcomes by engaging in interpersonal dialogues, interactions, and scaffolding of online activities. This element was supported by Alqurashi (2018) in her analysis on LII showing that it was deemed the second highest predictor of perceived learning, with a unique variance of 4.5% in perceived learning, after OLSE scoring a 6.5%. This interaction was observed from two sides: learners and instructors. For the learners' part, it involved asking and answering questions during classes, receiving feedback, and participating in online discussions. For the instructors, it involved their responsibilities in providing support and guidance to their students, assisting them with their needs, ensuring that they can make progress, motivating them, and helping them practice those learnings (Moore, 1989 as cited by Alqurashi, 2019). It is, therefore, vital that the interaction between the learners/students and the instructors/teachers were emphasized to attain student satisfaction and the learning outcomes of the lesson in an online learning environment.

Interactions between students and the content are regarded as significant in influencing the online learning system, according to Nortvig et. al (2018), as well as Alqurashi (2019). This factor pertained to the interaction between the student and the subject matter. Alqurashi (2019) reviewed a study on predictors affecting student satisfaction in online learning environments and discovered that the interaction between these two variables strongly predicted student satisfaction, which was reported to have a high, positive, and significant correlation with the learner-instructor interaction. However, results from her study proved that it is the third highest predictor, after the learner-instructor interaction with a unique variance of 3.8%. After a thorough review of Nortvig (2018) on four (4) journals related to these interactions, students in an online learning environment needed a feeling of connection to the educator, to other students, and the course content itself. This can be attained in a supportive environment by providing audio, video, synchronous and asynchronous discussions, practical activities, and other online activities promoting student engagement (Gray & DiLoreto, 2016 as cited by Nortvig et. al, 2018). As for the learner-content interaction, a significant effect was observed on perceived learning, student satisfaction, and course quality (Sebastianelli et. al, 2015 as cited by Alqurashi, 2019).

Other factors that also have a significant role in building up the online learning system are educator presence in online settings, designed connections between online and offline activities

along with campus-related and practice-related activities, and online learning self-efficacy (OLSE). The factor of educator presence in online settings focuses on the roles of educators and their relations with the learners, who are the facilitators of online learning. To enhance this component, the authors of this study summarized from reviews that educators must first establish a strong presence in online settings through regular communication with students, consistent feedback, and critical discourse modeled by the educator (Gray & DiLoreto, 2016 as cited by Nortvig, et. al, 2018). Second, building online learning communities was another way to create connections with fellow learners and establish a trusting relationship with students necessary to develop their knowledge (Cho & Tobias, 2016 as cited by Nortvig, et. al, 2018).

Furthermore, designing connections between online and offline activities along with campus-related and practice-related activities, were factors that highlighted the significance to foster coherence between online and offline activities to promote the blended learning method.

Online learning self-efficacy (OLSE), on the other hand, is a factor identified by Alqurashi (2019). It pertains to the level of confidence that someone needs to perform a certain task, activity, challenge, or action done online (Alqurashi, 2016 as cited by Alqurashi, 2019). Therefore, the amount of confidence a student must do schoolwork or perform activities online has a significant effect on the effectiveness of the online learning system. According to the same study, it scored the highest in unique variance in perceived learning in her study. This means that it is the strongest predictor of perceived learning.

The above-mentioned factors were essential in improving the academic performance of the students. Through the synergistic interaction among learners, instructors, and the content of the course studied, presence of the educator, equilibrium between online and offline activities along with extracurricular activities and OLSE, these can aid in allowing students to continue attaining and striving for high standards in their academic performance.

Online learning opens opportunities for students. It can either be fully online or blended learning according to Horn and Staker (2012) wherein elements of this were combined with the normal face-to-face setup. It can simply be defined by using only two words- Knowledge and technology. The NCA Higher Learning Commission defined it as:

"For the purposes of accreditation review, Distance Education is defined as a formal educational process in which the majority

of the instruction occurs when the student and instructor are not in the same place. Instruction may be synchronous or asynchronous. Distance education may employ correspondence study, audio, video, or computer technologies." (Keairns, 2003.)

Despite online learning's numerous advantages and possibilities for better and innovative learning, countries are still not prepared for this new set-up. It was difficult to retain online courses due to low participation from the students or employees (Marcial, Dennis, & Rendal, 2015). The calculations were said to be 10 to 20% lower compared to face-to-face learning. In the same manner, the US News and World Report announced that the average retention rate among first-time part-time students is 39% (Burnsed, 2010). Rob Jenkins from the Chronicle of Higher Education also suggests that students would more likely drop or fail an online course than in a face-to-face setting.

The study of this article aimed to determine the barriers of online learning among professors in higher education in tertiary schools or higher education institutions. A survey was distributed among teachers from provinces from all three (3) islands of the Philippines. The survey was adapted from Muilenburg and Berge wherein each barrier should be rated from 1-5, with 1 for not being a barrier, 2 for being somewhat of a barrier, 3 for being a barrier, 4 for being a strong barrier, and 5 for being a very strong barrier. With a sample size of 27 female respondents and 7 male respondents, they were able to accumulate their responses from the survey and summarize them in this figure:

Fig. 1. Measuring of Barriers of Online Learning in the Philippines

Summary of Results		
Issues	Weighted Mean	Description
Cost and Access to the Internet	3.68	A strong barrier
Technical Problems	3.50	A strong barrier
Technical Skills	3.11	A barrier
Administrative/Instructor Issues	3.02	A barrier
Learner Motivation	2.78	A barrier
Academic Skills	2.67	A barrier
Time and Support for Studies	2.61	A barrier
Social Interactions	2.53	Somewhat of a barrier
Mean of Means	2.99	A barrier

Figure 1 showed the ranking from most severe barrier to least severe barrier as perceived by the respondents. The most severe barrier was the issue of cost and access to the Internet (overall mean, 3.68 – a strong barrier), and the least severe barrier was the issue of social interactions (overall mean, 2.53 – somewhat of a barrier). The study revealed that aside from the issue of the cost and access to the Internet, technical problems ranked as the second highest barrier to open online learning, with a weighted

mean of 3.50. To note, in Muilenburg & Berge (2005), cost and access to the Internet ranked only sixth, whereas social interactions issue ranked first or most severe barrier. Both became opposite poles to the results in this study. The overall mean of the eight barriers considered for this study was 2.99 – a barrier. Furthermore, administrative or instructor issues, academic skills, technical skills, learner motivation, and time and support for studies were barriers to online learning (Marcial., et al. 2015).

The study concluded that to resolve these issues, there is a need for the Philippines to invest in internet bandwidth and infrastructure. It was also important to recruit teachers who are highly knowledgeable regarding online learning.

However, a factor that affected the online learning experience of the students along with their academic performance and circadian rhythm based on their gender was the current situation, the CoViD-19 pandemic, that forced people to adjust to many changes such as undergoing online learning as a substitute for face-to-face classes. As of October 6, 2020, the Philippines had been heavily impacted by COVID-19. HEIs had no other option but to cancel face-to-face learning and switch online. The schools that had initiated this shift were the top universities in the country such as De La Salle University, Ateneo de Manila University, University of Santo Tomas, and the state-run University of the Philippines. Other private universities and institutions shortly followed. Despite the attempt of these HEIs to adhere to the government's requirement that learning must still be continued regardless of the pandemic. Student governments petitioned the cancellation of classes due to numerous reasons. The petitioners argued that "access to the internet connection and learning devices continued to be a privilege up to this day, placing those with poor internet access at a disadvantage when it comes to online classes." Many Filipinos and public schools have no privileges on internet access. Furthermore, "adding more workload for the students increases their burden and contradicts the purpose of the lockdown, which is to help their families prepare and adjust to the situation at hand." Finally, there was an issue about the "lack of environments conducive to learning at home and the effectiveness of the online lectures" (Bagayas, 2020).

The Philippines also does not have concrete national policies regarding online platforms such as Massive Open Online Courses (MOOCs), Open Distance e-learning (ODEl), and Open Educational Resources (OERs). One law established for the educational sector, *Open Distance Learning Act*, explains that all online platforms must be provided with a legal base for

funding. Unfortunately, it has not been able to grow since no other existing laws support this or elaborate on it.

The author of this article later concluded that this may have paved the way for these said countries to improve and look back on the current educational system and see what needs changing. For the Philippines, numerous factors should be considered such as teacher capacity, situation, and context of the learner, learning environment, internet speed, cost of materials, and mode of delivery. De Vera from CHED claims that these challenges can be surpassed through unity and coming together through these difficult times.

In the context of the University of Santo Tomas (UST), plans to continue providing education during the CoViD-19 pandemic through online means have been devised by the authorities within the college, which include the professors, department chair and the dean of the college, together with the administration of the university's educational technology center or EdTech and the executive administration of the university, who are the rector, the vice-rector and the secretary-general of the university. These were drafted in a set of institutional guidelines entitled "Collective Institutional Guidelines for Prevention and Control of the Coronavirus Disease (COVID-19)", as released by the Office of the Secretary-General on March 14, 2020, while a more updated and college-specific set was released by the Office of the Dean from the Faculty of Pharmacy on August 10, 2020. These were both released through their respective pages on the social media platform, Facebook.

Classes are delivered through the UST Cloud Campus, as mandated in the Faculty of Pharmacy Implementing Guidelines (FOP IGs) (2020). This includes the use of Blackboard, an educational application, and website, Zoom, a video conferencing application, and Google Workplace, a platform by Google which includes a set of collaboration tools such as Calendar, Chat, Docs, Drive, Forms, Gmail, Meet, Sheets, Sites and more. These will be delivered in two (2) ways: asynchronous and synchronous sessions. An asynchronous session involved self-paced learning, wherein students are given learning resources such as PowerPoint presentations, handouts, recorded discussions on a particular topic, and formative assessments for them to use to learn the lesson by themselves. Synchronous sessions, on the other hand, involve live participation of students using the available video conferencing resources such as Zoom, Blackboard Collaborate, or Google Meet, wherein an instructor explained the lesson to the students and discussed these with them. Given that the

strength of the internet connection differs among students, both sessions differ in different levels according to these three (3) categories: Category 1: students who have no capacity and internet connectivity, Category 2: students with limited capacity and/or weak/intermittent internet connectivity, and Category 3: students with full capacity and strong internet connectivity.

For assessments such as practical examinations, formative and summative assessments, the students are given at least (3) up to a maximum of seven (7) graded assessments per shifting period. The examinations for professional courses are departmentalized, wherein all instructors assigned in a certain course furnish the content of the examination. The examinations for the general education courses are encouraged to be departmentalized.

These examinations will be monitored and managed by administrators and professors from the Faculty of Pharmacy according to the Implementing Guidelines approved and authored by the Dean. As stated in the FOP IGs, one guideline is that the instructors will set a time limit for the test and students will be allowed to take the examination with one (1) attempt only. Additionally, if the student missed any of the shifting examinations, he or she will be given a special shifting examination on completion day. If a student is caught cheating in any form of assessment, he or she will be given a mark of zero (0) for the given examination and referred to the social welfare and development (SWD) coordinator of the Faculty of Pharmacy for due action or to the Guidance Counsellors for proper guidance, according to the FOP IGs.

Given the new academic protocols implemented to continue providing quality education to the students enrolled under the UST Medical Technology program amidst the CoViD-19 pandemic, changes were observed in the study habits of the students as they pursue their learnings online. While they continue to adapt to the online learning environment, a different set-up from the usual face-to-face learning alternative, the students, as well, must make several adjustments with their daily routine to keep up with the workload and curriculum. These adjustments include attending synchronous sessions, while at the same time keeping track and following through with the asynchronous study guide and performing the tasks given to them. This new approach, therefore, had coerced some, if not most of the students to change their circadian rhythms, which in return affects their academic performance.

Morningness-Eveningness Questionnaire:

To measure the circadian rhythm of an individual, the questionnaire Morningness/Eveningness Questionnaire (SMEQ) is utilized (Honne & Osberg, 1976). Determining the circadian phase preference can be done through the individual's physiological indicators like dim light melatonin onset and minimum core body temperature (Crowley et al., 2006; Kerkhof et al., 1980; Lack et al., 2009; Lavie & Segal, 1989). This questionnaire assesses the preferred clock time of sleep and activeness in situations along with the assessment of morning alertness and appetite, evening tiredness, and clock reliability. Several studies stated that the MEQ is reliable and valid to different countries (Di Milia et al. 2013; Lee et al. 2014; Concepcion et al. 2015; Roveda et al. 2017), suggesting that the score limit is due to the factors of age, gender, cultural variations, puberty, and season of birth (Adan and Natale 2002; Caci et al. 2009; Kim et al. 2002). *B. Theoretical Study*

According to various studies concerning circadian rhythms, all body organs are affected by biological rhythms. It signifies that body rhythm is used as a criterion to classify different people in terms of performance (Liaghatdar et al., 2016). This suggests that people have their biological rhythms such as wake time, bedtime, and time wherein they are at their peak performance (Milić et al., 2020). To determine the relationship between circadian rhythm and gender with the academic performance of Medical Technology students, the study utilized the survey-based, empirical model (SM) as a basis for the general outline of the study. It primarily focuses on the students' self-reported chronotype and times they feel at their peak performance. This model classifies which time medical students perform to the best of their capabilities (Evans et al., 2017). The variables included in the study determine which self-reported chronotype greatly contributes to the academic performance of the Medical Technology students.

C. Conceptual Framework

Understanding the correlation between gender and chronotype with the academic performance of Medical Technology students is an understudied phenomenon. To delve into this topic more deeply, it aims to focus on how each variable, working time, and the gender of the students with academic performance, affect each other in different ways, as represented in the framework shown below. Each arrow represents how one variable affects the other. The diagram found in the succeeding page is a revised version of Rahar et al. (2015) in their study.

Preferences of an individual, whether male or female, deliver an impact on human behaviors and growth (Alzahrani, Park, & Tekian, 2018). Based on the ideas accumulated from the

findings of previous literatures, the researchers can suggest that an individual’s studying habits can arise due to conscientiousness, neuroticism, openness, extraversion, and agreeableness which could be the causes for becoming a “morning type” or “evening type” of person. These conditions include class schedules that may vary, wherein some may have early morning classes at 7:00 in the morning, but some may also have classes in the afternoon only, which can affect the sleeping pattern of a student, thus affecting the circadian rhythm. The morningness and eveningness of a person may also be affected by factors such as caffeine intake, in which the given stimulant is a component found in energy beverages and food, the environment the person is in, the emotional factors that can affect the well-being of a person, and one’s personal preferences that can affect whether they feel like engaging in certain activities in the morning or in the evening.

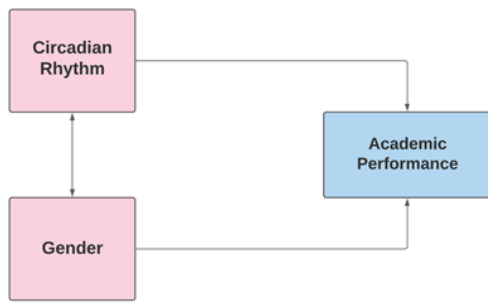


Fig.2. A conceptual framework representing the correlation between circadian rhythm and gender with academic performance

III. RESEARCH METHODS

A. Research Design

The researchers followed a correlational research design to determine the relationship between circadian rhythm and gender with academic performance. This design is a type of descriptive study that involves observing two (2) variables to establish a statistically corresponding relationship between them.

According to Manuel and Medel (1998), descriptive research involves the description, recording, analysis, and interpretation of the present nature, composition, or processes of phenomena. With the study as a descriptive-correlational type, the researchers have collected detailed information to describe the existing phenomena. Through this design, they were able to

systematically describe the situation or area of interest accurately.

The findings of this study aim to explain and describe the phenomenon of what already exists and correlate it to the variables which are the circadian rhythm and gender of the Medical Technology students.

B. Sampling Design and Respondents

The respondents of this study consisted of students under the Medical Technology program at the University of Santo Tomas. The sampling technique used was the Convenience Sampling, which is a type of non-probability sampling. The participants are sampled simply because they are convenient sources on certain year levels of University of Santo Tomas. Raosoft is a type of software that was utilized in this study, and it provided the recommended number of sample size for this study. There were 45 sections from all year levels - 8, 10, 22, and 5 from first year to fourth year respectively. Among the 2,042 students who were currently enrolled in medical technology, from all four-year levels, only 360 respondents were selected. The respondents were selected with no proportionality to gender and year level. An expectation of 5% margin of error with 95% confidence level was seen from this collection.

Table.1. Tabulation of the Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
First Year to Fourth Year students of the Medical Technology program in University of Santo Tomas	Students not enrolled at University of Santo Tomas Students enrolled in other programs/courses at University of Santo Tomas
BS Medical Technology Students who are currently enrolled this SY 2020-2021 (online learning)	BS Medical Technology students who already graduated Incoming Medical Technology students Registered Medical Technologists

C. Instrumentation

The type of instrument that was mainly utilized in this study is survey research. According to (Check & Schutt, 2012), it is defined as the collection of information from a sample of individuals through their responses to questions. The questionnaire that was used is the Morningness-Eveningness Questionnaire (MEQ) (Horne and Ostberg, 1976), modified by Dr. Sarah Briggs (2015). It consists of 19 questions that ask people about their “feeling best” rhythms and indicate preferred clock time blocks for sleep and engagement in various hypothetical situations (e.g., physical exercise, tests, work), in

addition to assessing morning alertness, morning appetite, evening tiredness, and alarm clock dependency. An additional question about the grades of the respondents was included to see the correlation between their morningness or eveningness type to their academic performance. The questionnaire was posted in Google Forms for accessibility and accuracy.

D. Data Gathering Procedure

The researchers have decided to use primary data as the basis for this study to ascertain the following objectives and decide whether to accept or reject the null hypothesis, as mentioned in the second chapter of this study.

Before disseminating the survey-questionnaire to the sample population, the researchers performed a pilot test in which thirty (30) volunteers were asked to fill it out. This was done to assess if the survey-questionnaire is working properly, and to gather feedback from the volunteers to improve it further.

After performing a pilot test, the researchers disseminated the survey-questionnaires among the students enrolled under the medical technology program of the University of Santo Tomas (UST), 2) organized the data collected using Google Sheets, and 3) had the responses of the sample analyzed statistically.

As aforementioned, the Morningness-Eveningness questionnaire, authored by Honne and Ostberg (1976) and modified by Dr. Sarah Briggs (2015) was used to gauge the circadian rhythm of the members of the sample population. This was distributed through digital means, particularly using a collaborative tool, Google Forms, to the respondents, as selected from the list of students obtained by the researchers from the Department Chair of the Medical Technology program. This was disseminated to the participants through a post of a publication material (pubmat) - seen on Appendix D - in Facebook group pages for Medical Technology students of UST and through online messaging platforms such as Facebook messenger. Both means were facilitated by the researchers themselves. The posting of pubmats, was designated to two members who coordinated with the admin of the group page to ask for permission to post. On the other hand, the means of online messaging platforms were done through constant communication and coordination with participants from different blocks who were acquaintances of the members to send to their classmates. The sample population is UST Medical Technology students from Batches 2021-2024, of which were selected through a convenience sampling wherein a non-probability sampling was utilized for data gathering.

The test was administered to the participants at certain times based on their schedules to avoid this procedure to interfere with the work of the students. This was made available for two (2) weeks for filling up by the students once it was disseminated. The deadline was set on the last day of the second (2nd) week. It was sorted out after, with the use of another collaborative tool, the Google Sheets, in which each column was categorized based on the classifications of data necessary for this research. The data were accumulated during the 2nd Semester of Academic Year 2020-2021.

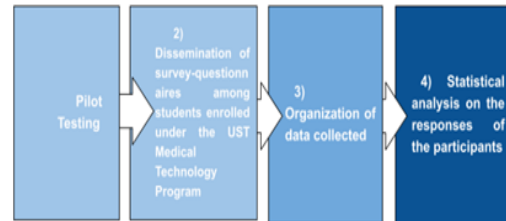


Fig.3. A visual representation of the procedure in data collection for this research study

E. Ethical Considerations

The researchers conducted a convenience sampling procedure in recruiting participants from Batches 2021-2024, enrolled under the Medical Technology program from the Faculty of Pharmacy at the University of Santo Tomas (UST) using social media - Facebook Messenger.

An informed consent, along with a set of terms and conditions, were presented at the beginning of the survey. This included the statement of the Data Privacy Act of 2012 (Republic Act No. 10173), to assure the respondents that their right to privacy is recognized and that the data that withhold the personal information of the students are protected. This included the responsibilities that the researchers hold, the rights of the participants with which they are entitled to and the penalties incurred for any violations performed against the law during the process of this research. Additionally, the researchers provided their contact details in the consent form for communication purposes.

The important information about the study, the research process, along with the duties and responsibilities as participants were further explained by the researchers. Moreover, the participants were given the freedom of choice to either participate in the study or not, as a sign of respect to each individual's autonomy. The students, who agreed to participate

in the study, were given a choice to either withdraw from participating or not. The researchers did not coerce the sample of this study into participating in the data-collecting procedure. Furthermore, they did not recruit the participants through monetary means.

This research group has appointed Mr. Paolo Antonio Patawaran, a member of this team, as a liaison among the researchers, the participants of the study and the authorities. He served as a contact person for the individuals of the sample population for further information regarding the study and in the event of any study-related injury. He provided his contact details to the members of each cluster to establish an open communication among the three parties.

The digital tools used are capable enough to accumulate and analyze data. The maximum storage of the tool employed, Google Drive is unlimited, and therefore can store as much data as possible.

A copy of this study was submitted to the Faculty of Pharmacy Research Ethics Committee (FOPREC) for approval of the research. All recorded data presented and discussed in the succeeding chapters remain confidential and anonymous by storing these in a storage tool, Google Drive and limiting its access to the researchers of this study, the statistician, adviser, members of the FOPREC, the Chair of the UST Department of Medical Technology and the readers or reviewers of this thesis paper. This is done as respect to the students' right to privacy and in compliance with the conditions stated at the beginning of the survey, and then in the next steps of the data collecting procedure.

F. Data Analysis

The demographic profiles and different levels of Medical Technology students were recorded to describe the background of the sample. These sets of information were used for correlation analysis. For developing the foundation of the study, the obtained data were gathered from the Likert scale questionnaires for analysis using frequency, percentages, measures of central tendency and variations. To perform a quantitative analysis on the data acquired, the researchers conducted the Fisher Freeman Halton Exact Test - an extension of Fisher Exact Test. This is a test of significance used in analysis of an rxc contingency table. This was used to analyze the categorical variables since the assumptions for a chi square test were not met.

IV. PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

A. Results

The purpose of this study was to determine if there was a significant relationship between circadian rhythm and gender, circadian rhythm and their academic performance, and gender to their academic performance. 360 students have participated, analyzed, and were consented to provide their GWA to progress further.

B. Demographic Profile

Table 2 shows the distribution of each category: Age, Gender, Year Level, Circadian Rhythm, and Academic Performance. There were 250 females (69.4%) and 110 males (30.6%) who were included in the study, with females having more in frequency. The same table illustrates the distribution of the circadian rhythm types and the distribution of the questionnaire to each year levels. There were 96 students (26.7%) on the first year level, 115 students (31.9%) on the second year level, 91 students (25.3%) on the third year level, and 58 students (16.1%) on the fourth year level. The most common circadian typology in the sample was intermediate type (63.6%) with 229 students, followed by the evening type (29.4%) with 106 students, with morning types (7%) - having 25 students, being the least common among them all. Followed by the Circadian Rhythm is the Academic Performance which was gathered based on their GWA during the first semester of the academic year.

Table.2. Demographic Results of the Samples

Demographic Results			
Category	Type/ Group	No. of Respondents	Percentage (%)
Age	18	32	8.9
	19	94	26.1
	20	102	28.3
	21	113	31.4
	22	15	4.2
	23	3	0.8
	24	1	0.3
Gender	Male	110	30.6
	Female	250	69.4
Year Level	1 st year	96	26.7
	2 nd year	115	31.9
	3 rd year	91	25.3
	4 th year	58	16.1
Circadian Rhythm	Evening	106	29.4
	Intermediate	229	63.6
	Morning	25	7.0
Academic Performance	Failed (5.00)	1	0.3
	Fair (2.50 - 2.75)	4	1.1
	Good (1.75 - 2.25)	104	28.9
	Very Good (1.25 - 1.50)	195	54.2
	Excellent (1.0)	56	15.6

195 of the students (54.2%) have achieved a grade of 1.25 - 1.50, next to 104 students (28.9%) with a grade of 1.75 - 2.25,

with 56 students (15.6%) having a grade of 1.0, and 4 (1.1%) students having a grade of 2.50-2.75 while one student (0.3%) had a failing grade of 5.00.

Relationship between the circadian rhythm of an individual and gender

Table.3. Cross Tabulation between Circadian Rhythm and Gender

Count		Gender	
		Male	Female
Circadian Rhythm	Definite Evening	1	8
	Moderate Evening	34	63
	Intermediate	65	164
	Moderate Morning	9	15
	Definite Morning	1	0
p-value		0.21	

In order to determine the correlation between the said objectives, Fisher Freeman Halton Exact Test was performed. Based on the objectives, two variables were considered to determine its significant relationship. Table 3 shows a distribution of males and females who preferred their own circadian rhythm. The most number of males and females fall on a circadian rhythm of “Intermediate” while “Morning” types have the least number of both males and females. H0 represented no significant relationship between circadian rhythm and gender while H1 represented significant relationship between circadian rhythm and gender.

The level of significance for the hypothesis test is 5%. From the Fisher’s Exact Test, the p-value showed a value of 0.21. Given the p-value of 0.210, which is greater than $\alpha = 0.05$, there was insufficient evidence to reject H0. This indicates that there was no sufficient evidence to conclude that there is a relationship between a person’s circadian rhythm and gender.

Relationship of gender with academic performance of Medical Technology student

Table.4. Cross tabulation between Gender and Academic Performance

Count		Academic Performance				
		Failed (5.00)	Fair (2.50 - 2.75)	Good (1.75 - 2.25)	Very Good (1.25 - 1.50)	Excellent (1.0)
Gender	Male	1	2	33	63	11
	Female	0	2	71	132	45
p-value		0.122				

Table 4 illustrates the analysis of the relationship between gender and academic performance, which was classified into five parts: *Failed* (5.0), *Fair* (2.50-2.75), *Good* (1.75-2.25), *Very Good* (1.25-1.50), and *Excellent* (1.0). There were 360 students who participated in the questionnaire. For male students, 11 students were *Excellent*, 63 students were *Very Good*, 33 students were *Good*, 2 students were *Fair*, and one student *Failed*. On the other hand, for female students, 45 students were *Excellent*, 132 students were *Very Good*, 71 students were *Good*, 2 students were *Fair*. In order to correlate the relationship between gender and academic performance, the Fisher Freeman Halton Exact test was utilized.

H0 demonstrated no significant relationship between gender and academic performance, whereas; H1 represented a significant relationship between gender and academic performance. The level of significance for the hypothesis test is 5%. The p-value obtained from the Fisher’s Exact Test was 0.122. The value is greater than $\alpha = 0.05$, indicating that there is no sufficient evidence to conclude that there is a relationship between gender and academic performance.

Correlation of circadian rhythm with the academic performance of the Medical Technology students

Table.5. Cross Tabulation between Circadian Rhythm and Academic Performance

Count		Academic Performance				
		Failed (5.00)	Fair (2.50 - 2.75)	Good (1.75 - 2.25)	Very Good (1.25 - 1.50)	Excellent (1.0)
Circadian Rhythm	Definite Evening	0	0	1	6	2
	Moderate Evening	1	2	25	55	14
	Intermediate	0	2	72	120	35
	Moderate Morning	0	0	5	14	5
	Definite Morning	0	0	1	0	0
p-value		0.616				

From the questionnaire, three categories are to identify the respondents: 16-41 as evening type, 42-58 as intermediate type, and 59-86 as morning type. Table 5 depicts the different types of circadian rhythm among Medical Technology students to their academic performance, which is categorized into six parts. There were 360 students who participated in the questionnaire. For evening circadian rhythm, 16 students were *Excellent*, 61 students were *Very Good*, 26 students were *Good*, 2 students were *Fair*, and one student *Failed*. For intermediate circadian rhythm, 35 students were *Excellent*, 120 students were *Very Good*, 72 students were *Good*, two students were *Fair*, and no student *Failed*. On the other hand, for morning circadian rhythm, 5 students were *Excellent*, 14 students were *Very Good*, and 6 students were *Good*. In order to correlate the relationship between Circadian rhythm and academic performance, the Fisher Freeman Halton Exact test was utilized. H0 represents no

significant relationship between circadian rhythm and academic performance whereas; H_1 represents a significant relationship between circadian rhythm and academic performance. The level of significance for the hypothesis test is 5%. The p-value obtained from the Fisher's Exact Test was 0.616. The value is greater than $\alpha = 0.05$, indicating that there is no sufficient evidence to conclude that there is a relationship between a person's circadian rhythm and academic performance.

B. Discussion

There have been changes in the academic performances of the students with the online learning system initiated by the university to continue delivering quality education to the students. This study emphasized the significant correlation between the variables, namely circadian rhythm and gender, with academic performance among Medical Technology students of the University of Santo Tomas. It provided relevant information regarding certain factors that may affect the quality of learning guided by the information and findings within other related studies. The information and data that was collected from this study could be used as a source to gain more insight in understanding the biological determinants of a person's academic performance in the current online learning system. This quantitative study was analyzed with an existing tool called Fisher Freeman Halton Exact Test, which is used to evaluate the degree of independence between the variables. The null hypothesis states that the academic performance among Medical Technology students of the University of Santo Tomas AY 2020-2021 does not correlate with their circadian rhythm and gender. In order to identify the correlation between the given variables, examination was further broken down into pairs: videlicet, circadian rhythm and gender, gender and academic performance, and circadian rhythm and academic performance. Based on the findings obtained, the researchers can concur that there was no significant correlation found in the aforementioned variables. The results will be explained further in accordance with the objectives of this study.

Demographic Results of the Sample:

The participants of this study included three hundred and sixty (360) students who are currently enrolled in the Medical Technology program of the University of Santo Tomas. The demographic profile of the respondents are tabulated according to age, gender, year level, circadian rhythm, and academic performance based on the answers they provided.

With regards to age, the majority of the respondents were 21 year old, with one of them, 24 years old. For gender, most of the participants were female, comprising 69.4% of the sample population. For year level, 31.9% of them were mostly 2nd Year students, while 16.1% of them were the 4th Year students, who comprised the least of the sample population.

As for circadian rhythm, 63.6% of the respondents chose the 'Intermediate' classification, the most numerous compared to the number of respondents in other categories. The least of them chose the 'Morning' classification, comprising 7% of the sample population. Finally, 54.2% of them belonged to the 'Very Good' group, while the least came from the 'Failed' group, comprising 0.3% of the respondents.

Circadian Rhythm and Gender:

The first objective of this study is to observe for any existing, significant correlation between circadian rhythm and gender. Based on statistics, the majority of the respondents identified themselves as the intermediate type which refers to the option of being a "rather more of a 'morning' type than an 'evening' type" person or a "rather more of an 'evening' type than a 'morning' type" one. Out of 360 participants, 229 chose this option, which consisted of 164 females and 65 males. The option with the second highest number of votes is the 'moderate evening' picked by 97 participants, 63 of whom are female and 34 are male. Next is the 'moderate morning', an option that was voted for by 24 participants of 15 females and 9 males. It is then followed by the 'definite evening' with 9 students, which consisted of 8 females and 1 male. Lastly, the option with the least number of votes is the 'definite morning' with only 1 male student choosing this answer.

After the results were analyzed using Fisher's Exact test, a p-value of 0.21 was obtained which is greater than the significant value of 0.05 hence no significant relationship was found between the two variables. The circadian rhythm of the students may have been developed due to the different class schedules, time differences based on their location, or other personal commitments.

These results did not garner the same in the study conducted by Pedrelli et al. (2017) which states that gender affects a person's circadian rhythm to the point where women are more prone to stress and depression which contributes to lower quality of sleep. However, the result of this study coincides with the findings of Natale, Adan, and Fabbri in 2009 in their paper entitled Season of Birth, Gender, and Socio-Cultural Effects on Sleep Timing Preferences in Humans wherein it was stated that

even though the duration of sleep is highly linked to biological factors (gender), the time of awakening, determining a person's circadian rhythm, has no significant relationship with gender and is more correlated to socio-cultural factors and season of birth.

Gender and Academic Performance:

The next objective focused on the relationship between gender and academic performance. The participants of the study were asked to select a range for their general weighted average from the first semester of Academic Year 2020-2021. Among the six classifications which are Failed (5.0), Passed (3.00), Fair (2.50-2.75), Good (1.75-2.25), Very Good (1.25-1.50), and Excellent (1.0). 10% of the male participants and 18% of females had an Excellent GWA. 57% of males and 53% of females got Very Good, 30% of males and 28% of females got Good, 2% of males and 1% of females got Fair, and lastly, 1% of the males and none from the females had a Failed grade. These findings may have been an outcome of the disproportion between female and male students, in which both genders were able to perform well in their academics. In addition to that, external factors such as the studying environment and resources may have contributed to the student's academic performance.

Upon probing these results to Fisher's Exact test, no significant correlation was found between gender and academic performance, with a p-value of 0.122. One of the studies that contradicted this finding was written by Stegers-Jager, Savas, van der Waal, van Rossum and Woltman (2020), which showed that female students had a significantly higher Year 1 passing rate than male students. However, one of the findings from a related literature authored by Joseph, John, Eric, Yusuf and Olubunmi (2015) favored the results of this study, in which it said that "there was no significant difference in the slightly better performance of the male students with their female counterparts in computer studies, with the t-test value ($t = 0.08$) higher than the significant value (0.05). According to the authors, this was the outcome because of the similarity in the academic performances between the female and male students, along with certain variables that the students were exposed to.

Circadian Rhythm and Academic Performance:

The final objective for this study is to assess the correlation between circadian rhythm and academic performance. Table 5 shows that a majority of the students selected the 'Intermediate' Group for their circadian rhythm, with 229 out of 360 of the respondents. An 'Intermediate' circadian rhythm may be defined as being neither an 'Evening' or 'Morning' type of

person. This is followed by the 'Moderate Evening' Group, selected by 97 of the participants, then the 'Moderate Morning' Group with 24 responses from them, then the 'Definite Evening' group chosen by 9 of the participants, while the least came from the 'Definite Morning' with only one participant selecting this option. As for their academic performance, the 'Very Good' category (1.25 - 1.50) made up 195 of the participants, followed by the Good category (1.75 - 2.25) with 104 of them, then 56 of the respondents choosing the Excellent category (1.0), then 4 of them for the Fair category, and 1 student for the Failed category. This finding proves that the students are still able to perform well in their academics despite most of them having an Intermediate type of circadian rhythm, and next to that, being more of an evening type of person, contradicting the study of Gomes, Tavares, and Azevedo (2002), wherein they stated that eveningness is associated with poor academic performance, as an outcome of evening persons' lack of sleep. The same applies to the study of Randler and Frech (2006; 2009) who wrote that morning chronotypes performed better than evening chronotypes, who had received poor results, in contrast to the finding of this study. On the other hand, this result is consistent with the findings of Thacher (2008) that there is no apparent relationship between chronotype and academic performance.

Contrary to the studies on the relationship between circadian rhythm and academic performance, the researchers have observed that there can be no significant relationship found, given that the p-value of 0.616 was greater than the $\alpha = 0.05$ after performing the Fisher's Exact test. In addition to that, when the students were asked whether they are a morning type or evening type of person, most of them responded with 'intermediate', accounting for 63.6% of the total number, as displayed in Table 3. However, the same table also shows that 29.4% accounts for the students who chose the option of being an evening type, while the remaining 7.0% for the students who responded with being a morning type. This result suggests that there are more students who lean towards having an evening chronotype than those with a morning chronotype.

The probability that a variable would get a value that is greater than or equal to the observed values just by random chance is called the P-value. A p-value that is 0.05 or lower would be considered significant as this denotes a strong evidence against the null hypothesis. The p-values obtained using Fisher's Exact Test were 0.210, 0.122, and 0.616, respectively — all of which are greater than $\alpha = 0.05$ which implies that evidence needed to conclude the existence of a significant relationship between any

of the pairs is insufficient. Therefore, the findings from the data analysis imply that there is no significant correlation between circadian rhythm and gender with academic performance of the Medical Technology students in the University of Santo Tomas.

Limitations of this study included the sample size with no proportionality to gender and year level, which may have restricted the researchers' ability to differentiate the capability of each year level in demonstrating their academic performance with varied subject courses. Second, the chronotype and academic performances, which were self-reported by the participants, should have been replicated with a more objective approach.

V. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

A. Summary

The purpose of this study was to determine the significant relationship of circadian rhythm and gender of an individual with the academic achievement of first to fourth year BS Medical Technology students of the University of Santo Tomas. The objective was to evaluate if these variables could affect the general weighted average of the students. Several studies determined that academic performance can be affected by the differences of an individual based on their study habits, preferences, and how well they perform during the morning or the evening.

This study utilized the survey-based, empirical model (SM) for the general outline of the study to achieve the objective stated. The researchers conducted a descriptive-correlational study that enabled the observation of variables if there is a corresponding relationship or correlation between them using specific and factual information and statistical instruments to identify the degree of relation. Convenience sampling was performed because the participants needed for the study was restricted within the first to fourth year medical technology students of the University of Santo Tomas enrolled for the first semester, SY 2020-2021. A survey questionnaire, specifically the Morningness-Eveningness Questionnaire (Horne and Ostberg, 1976), modified by Dr. Sarah Briggs (2015), was used which contains the variables of interest in the study and this was disseminated through online mediums such as google forms. 360 students have participated and results were analyzed using the Fisher Freeman Halton Exact Test which evaluated the degree of correlation between the variables.

Once the data was gathered and analyzed, results showed that most of the students were females and the most common

circadian typology was 'intermediate type' while the least common was 'morning type.' During the first semester of the academic year 2020-2021, the majority of the students achieved a grade of 1.25 - 1.50 while one student had a failing grade of 5.00. Furthermore, the study showed that the circadian typology of 164 female students and 65 male students were 'intermediate type' followed by 63 female students and 34 male students were 'moderate evening type' and the least common type was 'definite evening' for both genders. By using Fisher's Exact test, the result has no significant relationship between the circadian rhythm of an individual and gender. In line with this, the study also showed that there is no significant relationship between gender and academic performance. Finally, based on the results, the researchers concur that there is no correlation between a person's circadian rhythm and academic performance. Thus, the circadian rhythm and gender are not dependable measurements to the academic performance of the medical technology students in University of Santo Tomas.

B. Conclusion

Based on the data gathered, there was no sufficient evidence to conclude a significant correlation between circadian rhythm, gender, and academic performance of Medical Technology students of the University of Santo Tomas. Despite not having significant evidence for the correlation of the variables towards the academic performance of medical technology students, this study may still provide an aid for students struggling with their academic performance in an online setting considering other factors that need to be addressed to improve what is lacking. Students may have various learning strategies, but by making an individual more aware of his/her own study habits may help when it comes to finding ways to improve one's academic performance in school. The Medical Technology students from the University of Santo Tomas were observed to have high general weighted average (GWA) despite their differences in circadian rhythm and gender. This may indicate that academic performance depends mostly on the individual and their own study habits. Academic performance of students may be affected by several external factors outside this study's variables. This study states the importance of knowing the students' needs and internal or external factors that may affect them for the improvement of their academic performance.

C. Recommendations

The recommendations of this study include, but are not limited to:

- Since the study has only included students studying in UST, future researchers could expand the concentration of students to other schools/universities outside of University of Santo Tomas.
- The results of this study showed a disproportion of male to female participant's thus future researchers could ensure a balanced number of participants for both male and female gender for more accurate findings.
- Future researchers could also take into account external factors affecting the students' academic performances and circadian rhythms.

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