Frequency of computer vision syndromes among students during COVID-19 lockdown – a single school study in Malaysia

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ABSTRACT

Introduction: To determine the frequency of computer vision syndromes among students during COVID-19 lockdown in Malaysia.

Materials and Methods: This is a cross-sectional survey study. A total of 145 subjects studied in secondary school and pre-university programme were involved in this study. An exploratory survey questionnaire was used to assess the symptoms of computer vision syndromes encountered by the students and their electronic device usage behavior before and during fully remote learning started.

Results: Average time spent by students on outdoor activities reduced from one to two hours per day (40.7%) to less than an hour per day (56.6%) after fully remote learning. Average time spent on entertainment activities using electronic devices increased from one to two hours per day (38.6%) to four hours and above per day (40.0%) after fully remote learning. The majority of time spent on school assignments using electronic devices increased from one to two hours (44.8%) to three to four hours per day (33.8%) after fully remote learning. Increased frequency of students experienced eye pain (44.1%), eye fatigue (57.2%), headache (56.6%), eye itchiness (18.6%), glare (31.7%), dry eye (40.0%), blurry vision (31.7%) and double vision (7.6%) after fully remote learning began.

Conclusion: An observed increase frequency of computer vision syndrome was noted in relation to the reduction of time spent on outdoor activities and increased usage of electronic devices for entertainment activities and completing school assignment during COVID-19 lockdown in Malaysia.

KEYWORDS:
computer vision syndromes; digital eye strain; electronic device usage behaviour; high school students

INTRODUCTION

Computer usage has extended greatly into our daily live raise the controversy of high electronic device usage and increase in screen time.[1] A recent report released in April 2021 found that there are currently 5.18 billion active internet users across the world, accounting for more than 60% of the global population.[2] Some support the idea that smart devices ease the learning process and improve quality of life,[3,4] but the others have opposed opinions. For instance, long-time exposure to visual display terminals has adverse effects on ocular and visual health, including blurred vision, ocular discomfort, and dry eye.[5] These groups of symptoms caused by visual display terminals are known as Computer Vision Syndrome (CVS).[6] Computer vision syndromes is a group of symptoms related to prolonged work using visual display terminal.[7] Computer vision syndromes also include other symptoms such as eye pain, eye fatigue, glare, double vision, headache, and neck and shoulder pain.[8]

Since the mid-term of 2019, the world has been hit with COVID-19 virus. Aggressive government policies were implemented immediately to combat the deadly pandemic,[9] with strict measures taken on social interactions by closure of public areas and prohibition of outdoor activities.[10] COVID-19 pandemic greatly impacted the lifestyles, health and work habits of all individuals.[11] To prevent further impact on global economic development, people started to adapt to the new lifestyle and shift their majority activities to online platforms. For instance, online meetings, remote working, online classes, online extra-curriculum program, and online grocery shopping.[12,13] A study conducted to investigate the association between digital screen time and digital eye strain during COVID-19 pandemic. The study reported that in this research sample, there was a notable rise in prolonged digital device usage during periods of home isolation, coinciding with a noticeable increase in the occurrence of digital eye strain during curfew implementations.[14]

The prevalence of quarantine measures and school closures has had a profound impact on the daily lives of school children. One significant consequence is that there has been a noticeable increase in the amount of time spent using digital devices, coupled with a rise in activities that require close up visual engagement. In tandem to that, there has been a significant reduction in outdoor activities as the circumstances necessitated staying indoors. While the

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duration of school closures might have been temporary, the extended period of reliance on digital platforms has led to a notable shift in behaviour and habits amongst children. This shift has fostered a heightened level of familiarity and comfort with digital tools, which causes them to have escalating reliance on electronic devices, which has the potential to endure beyond the COVID-19 pandemic.[15] The potential outcome of this should not be disregarded as it may affect children's wellbeing and development. Therefore, this study aims to identify: (1) time spent on electronic devices and physical activities before and after fully remote learning began due to COVID-19 lockdown, and (2) self-reported symptoms of computer vision syndrome before and after fully remote learning began due to COVID-19 lockdown.

MATERIALS AND METHODS

A cross-sectional survey study was conducted at Alice Smith School, Kuala Lumpur, within June 2021. The inclusion criteria of participants are students at their secondary level and pre-university program were recruited for voluntary survey responses. Students who were not fluent in English were excluded from the study. The subjects were required to answer the exploratory 36-item survey questionnaire of computer vision syndromes (Appendix A), based on their experience on symptoms related to computer vision syndromes and their electronic device usage behaviour before they started fully remote learning (May 2021) and after they started fully remote learning (June 2021) since COVID-19 lockdown.

RESULTS

A total of 145 students aged between 12 to 20 years in their secondary level and pre-university program were included in this study. 53 (36.6%) among the subjects were male and 92 (63.4%) were female.

Time spent on activities before fully remote learning

According to the subject response, 52 (35.9%) spent less than an hour for outdoor activity, 59 (40.7%) spent one to two hours on outdoor activities per day, 28 (19.3%) spent three to four hours on outdoor activities per day, and six (4.1%) spent more than four hours on outdoor activities.

For entertainment purpose, 21 (14.5%) spent less than an hour using electronic devices per day in average, 56 (38.6%) subjects spent one to two hours on electronic devices, 45 (31%) subjects spent three to four hours on electronic devices, while 23 (14.9%) subjects spent more than four hours on electronic devices in average.

Time spent on online extracurricular activities such as online yoga, handcraft, and other hobbies were reported. Seventy-four (51.0%) of the subjects spent less than an hour using electronic devices for online extracurricular activities, followed by 59 (40.7%) subjects who spent one to two hours per day in average, ten (6.9%) subjects spent three to four hours per day, and two (1.4%) subjects spend more than four hours per day on online extracurricular activities.

Thirty-seven (25.5%) among the subjects reported that, they spent less than an hour per day on electronic devices to complete school assignments, while 65 (44.8%) subjects spent one to two hours on electronic devices for school assignments, 26 (17.9%) subjects spent three to four hours on electronic devices for school assignment, and 17 (11.8%) subjects spent four hours on electronic devices for school assignment.

Time spent on activities after fully remote learning

In average, 82 (56.6%) spent less than an hour for outdoor activity, 54 (37.2%) spent one to two hours on outdoor activities per day, 7 (4.8%) spent three to four hours on outdoor activities per day, and two (1.4%) spent more than four hours on outdoor activities.

Thirteen (9.0%) spent less than an hour using electronic devices per day for entertainment purpose, 24 (16.6%) subjects spent one to two hours on electronic devices, while 50 (34.5%) subjects spent three to four hours on electronic devices, and majority (n = 58, 40.0%) of the subjects spent more than four hours on electronic devices for entertainment activities.

Time spent on online extracurricular activities such as online yoga, handcraft, and other hobbies were reported. Seventy-one (49.0%) of the subjects spent less than an hour using electronic devices for online extracurricular activities, 60 (41.4%) subjects who spent one to two hours per day in average, 7 (4.8%) subjects spent three to four hours per day, and three (2.1%) subjects spend more than four hours per day on online extracurricular activities.

Twenty-two subjects (15.2%) reported that, they spent less than an hour per day on electronic devices to complete school assignments, while 39 (26.9%) subjects spent one to two hours on electronic devices for school assignments, followed by 49 (33.8%) subjects spent three to four hours on electronic devices for school assignment, and 35 (24.2%) subjects spent four hours on electronic devices for school assignment.

Break interval while using electronic devices

Before fully remote learning was implemented, 37 (25.5%) subjects take break from screen use for less than an hour on average, 54 (37.2%) subjects take break from screen every hour, 40 (27.6%) subjects take break every two to three hours, and 14 (9.7%) subjects take break after screen time of four hours and above. After fully remote learning began, 38 (25.5%) subjects take break from screen use for less than an hour in average, 43 (29.7%) subjects take break from screen every hour, 37 (25.5%) subjects take break every two to three hours, and 27 (18.6%) subjects take break after screen time of four hours and above.

Self-reported break interval during online classes was recorded. Thirty-nine (26.9%) students reported that, break was taken less than every hour in average, 48 (33.1%) students reported taking break from screen hourly, followed by 34 (23.4%) students reported break interval for every two to three hours, and 24 (16.6%) subjects reported break interval for every four hours and above. Figure 1 illustrates the break interval of students before fully remote learning, during fully remote learning, and during online classes.

Table I: Time spent by students for different activities (n = 145)

Time spent on activities	Before fully remote learning	After fully remote learning
Outdoor activities		
< 1 hour	52 (35.9%)	82 (56.6%)
1 – 2 hour(s)	59 (40.7%)	54 (37.2%)
3 – 4 hours	28 (19.3%)	7 (4.8%)
> 4 hours	6 (4.1%)	2 (1.4%)
Entertainment (using electronic devices)		
< 1 hour	21 (14.5%)	13 (9.0%)
1 – 2 hour(s)	55 (38.6%)	24 (16.5%)
3 – 4 hours	45 (31%)	50 (34.5%)
> 4 hours	23 (15.9%)	58 (40.0%)
Extracurricular activities (using electronic devices)		
< 1 hour	74 (51.0%)	71 (49.0%)
1 – 2 hour(s)	59 (40.7%)	60 (41.4%)
3 – 4 hours	10 (6.9%)	7 (4.8%)
> 4 hours	2 (1.4%)	3 (2.1%)
School assignment (using electronic devices)		
< 1 hour	37 (25.5%)	22 (15.2%)
1 – 2 hour(s)	65 (44.8%)	39 (26.9%)
3 – 4 hours	26 (17.9%)	49 (33.8%)
> 4 hours	17 (11.8%)	35 (24.2%)

Computer vision syndromes

The ocular symptoms experienced by the students were assessed. Before the school started fully remote learning, 52 (41.6%) out of 145 subjects reported eye pain, 73 (58.4%) subjects had eye fatigue, 66 (52.8%) subjects had headache, 20 (16%) subjects had eye itchiness, 33 (26.4%) subjects had glaring, 48 (38.4%) subjects had dry eye, 39 (31.2%) subjects had blurred vision, and 6 (4.8%) among the subjects had double vision.

After fully remote learning began, there were 64 (44.1%) of the students experienced eye pain, 83 (57.2%) students had eye fatigue, 82 (56.6%) students reported headache, 27 (18.6%) students had eye itchiness, 46 (31.7%) had glare, 58 (40.0%) students reported dry eye, 46 (31.7%) students had blurred vision, and 11 (7.6%) had double vision.

During online classes, 47 (32.4%) subjects reported eye pain, 77 (53.0%) subjects had eye fatigue, 66 (45.5%) subjects had headache, 23 (15.9%) subjects had eye itchiness, 33 (22.8%) subjects had glaring, 49 (33.8%) subjects had dry eye, 32 (22.1%) subjects had blurred vision, and three (2.1%) among the subjects had double vision.

Frequency computer vision syndrome

Before fully remote learning, the majority of the students (40.7%) spent one to two hours per day on outdoor activities, shifted to less than an hour per day (56.6%) during fully remote learning. The majority of time spent on entertainment using electronic devices before fully remote learning was one to two hours per day (38.6%), increased to four hours and above per day (40%) during fully remote learning. The majority of time spent on extracurricular activities using electronic devices remained at less than an hour before (51%) and during fully remote learning (49%). The majority of time spent on school assignments using electronic devices was one to two hours (44.8%) before fully remote learning, increased to three to four hours per day (33.8%) during fully remote learning. According to the survey response, majority of the students take break from screen hourly before (37.2%) and after fully remote learning (29.7%). During online classes, the majority of the students (33.1%) take break from screen hourly as well. Table I shows the frequency of students and their time spent on outdoor activities, time spent on electronic devices for entertainment purposes, extracurricular activities and school assignments, and frequency of screen break.

Frequency of students experiencing Computer Vision Syndromes increased after fully remote learning began. Computer Vision Syndromes during online classes were reported, frequency of students experienced eye fatigue, eye itchiness and dry eye slightly increased, while frequency of students experienced eye pain, blurred vision and double vision during the online class reduced compared to before fully remote learning. Other than that, the frequency of students experienced headache and glaring remained as before fully remote learning. Figure 2 illustrates the frequency of students experiencing eye pain, eye fatigue, headache, eye itchiness, glare, dry eye, blurry vision, and double vision before fully remote learning, after fully remote learning and during online classes.

DISCUSSION

Survey results indicated that, majority of the subjects were using electronic devices for purposes of entertainment more than online classes and other purposes. As a result, fully remote learning method and online classes had mild effect on increasing symptoms of computer vision syndromes among secondary level and pre-university students in Malaysia. Although online classes itself does not have direct

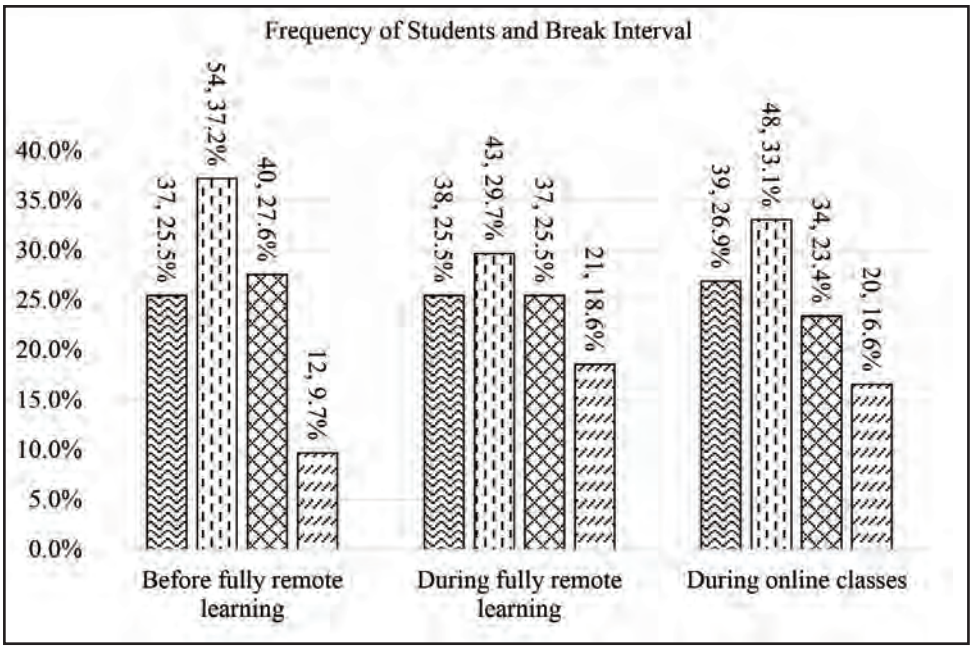

Fig. 1: Break interval during activities using electronic device

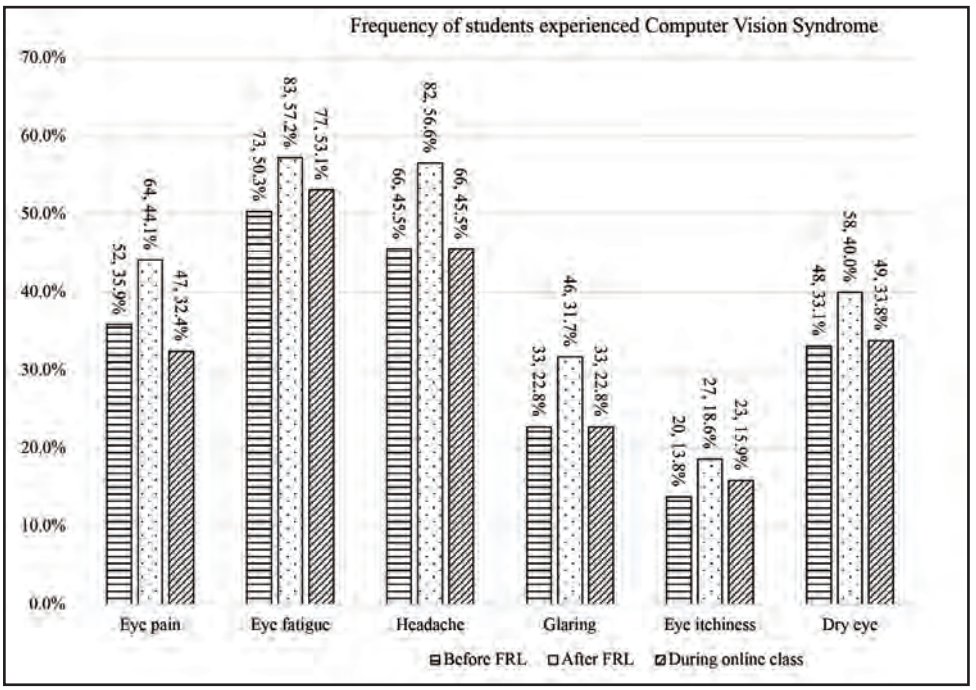

Fig. 2: Symptoms of CVS experienced by students in Malaysia (n = 145)

relation to computer vision syndrome, fully remote learning method due to strict movement control of residents resulted in a reduction for time spent of outdoor activities by the students, leading them to spend more time on electronic devices for entertainment and leisure with less self-limitation. Besides, the mode of school assignment has switched from hybrid (handwritten and digital assignment) to fully digital, which also leads to longer time spent on electronic devices.

Similar to this study findings, previous studies also reported that school-age children and young adults have increased internet usage during COVID-19 lockdown. A study done by Zandifar and Badrfam reported an increase in the access and usage of internet during COVID-19 lockdown. This is because COVID-19 pandemic has impacted various aspects of life, including the psychological well-being of populations, particularly among the young populations.[16] Previous studies reported an increase of stress, anxiety, and depression among the young populations during the pandemic.[17] By shifting to online education, young populations have relied heavily on digital platforms to keep in touch and connect with their friends and families.[18] Other than that, a study conducted amongst the young populations in Norway, examined the time spent on gaming and physical activities during COVID-

19 pandemic. The results showed that there was a notable increase in gaming activity during the initial COVID-19 lockdown in April 2020.[19] This hence points to the pandemic and its subsequent lockdowns had impact on the increase in digital engagement, not only for online classes, but also for other leisure activities.

Our study findings showed that there was an increase of students reported eye pain, eye fatigue, headache, glaring, eye itchiness, dry eye, blurred vision and double vision after fully remote learning began. This indicated that leisure activities using electronic devices impacted the ocular health and escalated computer vision syndrome among high school students in Malaysia. Similar study results were reported by previous studies. Bhattacharya et al.[20] studied on the computer vision syndrome among school-aged children in United Kingdom. The results reported 68% subjects had high usage of computers, and 54% among them started internet usage since the age of three, and the prevalence of computer vision syndrome was 69% among the adult subjects and 50% among the school-aged subjects.[20] Another study conducted in Lebanon has carried out a questionnaire among the working adults found that, subjects who transitioned to remote work had increased screen time and higher occurrence of experiences of computer vision syndrome. In which, these individuals were more susceptible to eye discomfort and eye strain due to prolonged usage of electronic devices.[21] Besides, a review to investigate the prevalence of computer vision syndrome during COVID-19 pandemic, reviewed subjects from 12 countries, resulting in 74% of subjects experienced computer vision syndrome during COVID-19 pandemic.[22]

According to the studied school and students, the average time for online classes was seven hours per day. Only symptoms of eye fatigue, dry eye and eye itchiness increased during online classes. This leads to an assumption where the increased of the symptoms might resulting from reduced blinking because the students were concentrating for learning. Earlier studies reported that, eye blink rate is significantly associated with level of attention, where blink rate reduced significantly with high attentive task.[23] Reduction of blink rate was a significant factor of evaporative dry eye associated with Meibomian gland dysfunction.[24,25] Other than that, implementation of online classes through virtual meetings significantly associated with eye fatigue experienced by students.[26] A study conducted by Kuwahara et al. reported that improper room lighting could lead to increase in eye fatigue.[27] However, there is a lack of published data on the standard or recommendation on the room lighting and screen lighting while using electronic devices for online classes and other activities.

The survey questionnaire used in this study was not validated due to time constraints for the study. However, the results may still psychometrically represent the targeted population in certain extent. One of the main limitations of this study is that the analysis was limited to descriptive statistics. This decision was based on concerns regarding the integrity and reliability of the data, as the questionnaire used was not subjected to validation or consistency tests, which might lead to biased outcomes and invalid interpretations. Therefore, future studies are needed urgently to address this limitation by employing validated and reliable tools, allowing for rigorous and statistical analyses that lead to a comprehensive and evidence-based conclusion. Besides, there is limitation due to the nature of self-reporting questionnaires, which there might be biases of the respondents according to their level of comprehension and psychological response. Furthermore, we acknowledge that recall bias may have affected the accuracy of reported symptoms and overgeneralizing the findings due to retrospective data collection resulting from the practical constraints during COVID-19 pandemic. In addition, the accuracy of the visual and ocular status has not been examined clinically, and the inter-rater reliability of the questionnaire items have not been studied. Therefore, the study results of the questionnaire might not be consistent or distorted, as there could be biases introduced among different questionnaire responders. Also, it is a single school study from an affluent area and may not represent the entire student population in Malaysia.

CONCLUSION

Reduction of time spent on outdoor activities, increased usage of electronic devices for entertainment activities and completing school assignments had an observed effect for computer vision syndrome after fully remote learning during COVID-19 lockdown. Therefore, it is advisable for the students to reduce time spent on unhealthy usage behaviour of electronic devices, especially on entertainment activities, and practice voluntary blinking exercise to reduce symptoms of dry eye and eye itchiness. The ministry of education and school authorities in Malaysia were aware of the break interval of students during online classes. However, eye care practitioners, school authorities and parents should work concurrently to raise awareness of the students about the impact of prolonged screen time to ocular and visual health. Besides, eye care practitioners need to understand the electronic usage behaviour of each patient for a better and effective management of computer vision syndromes.

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CONFLICT OF INTEREST

The authors declare they have no conflicts of interest.

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Appendix A

Survey questionnaire of computer vision syndromes

The following questions consists of **THREE SECTIONS,** please answer the questions in **SECTION A** based on your experience within **previous month (before fully remote learning)**, answer questions in **SECTION B** based on your experience within **this month (during the fully remote learning)**, and answer questions in **SECTION C** based on your experience **during online classes**.

Date

Name: **Age:** **Gender:** ☐ Male ☐ Female

SECTION A: BEFORE FULLY REMOTE LEARNING
Answer the following questions based on your experience within previous month: -

1. How many hours, on average did you spend for outdoor activities in a day?
   ☐ Less than 1 hour
   ☐ 1 to 2 hours
   ☐ 3 to 4 hours
   ☐ More than 4 hours

2. On average, how many hours a day did you spend on entertainment using electronic device(s)?
   ☐ Less than 1 hour
   ☐ 1 to 2 hours
   ☐ 3 to 4 hours
   ☐ More than 4 hours

3. On average, how many hours a day did you spend on completing school assignment using electronic device(s)?
   ☐ Less than 1 hour
   ☐ 1 to 2 hours
   ☐ 3 to 4 hours
   ☐ More than 4 hours

4. On average, how many hours a day did you spend on extracurricular reading using electronic device(s)?
   ☐ Less than 1 hour
   ☐ 1 to 2 hours
   ☐ 3 to 4 hours
   ☐ More than 4 hours

5. On average, how frequent did you take breaks from your electronic device(s)?
   ☐ Less than every hour
   ☐ Every hour
   ☐ Every 2 to 3 hours
   ☐ Every 4 hours and above

6. Did you experienced eye pain after using electronic device(s)?
   ☐ Yes
   ☐ No

7. Did you experienced eye fatigue after using electronic device(s)?
   ☐ Yes
   ☐ No

8. Did you experienced headache after using electronic device(s)?
   ☐ Yes
   ☐ No

9. Did you experienced glaring after using electronic device(s)?
   ☐ Yes
   ☐ No

10. Did you experienced itchiness of eye after using electronic device(s)?
   ☐ Yes
   ☐ No

11. Did you experienced dry eye after using electronic device(s)?
   ☐ Yes
   ☐ No

12. Did you experienced blurred vision after using electronic device(s)?
   ☐ Yes
   ☐ No

13. Did you experienced double vision after using electronic device(s)?
   ☐ Yes
   ☐ No

SECTION B: AFTER FULLY REMOTE LEARNING
Answer the following questions based on your experience within this month: -

14. How many hours, on average did you spend for outdoor activities in a day?
   ☐ Less than 1 hour
   ☐ 1 to 2 hour(s)
   ☐ 2 to 4 hours
   ☐ More than 4 hours

15. What type of electronic device(s) did you use?
   ☐ None
   ☐ Smartphone
   ☐ Tablet
   ☐ Laptop
   ☐ Desktop

16. On average, how many hours a day did you spend on entertainment using electronic device(s)?
   ☐ Less than 1 hour
   ☐ 1 to 2 hours
   ☐ 3 to 4 hours
   ☐ More than 4 hours

17. On average, how many hours a day did you spend on completing school assignment using electronic device(s)?
   ☐ Less than 1 hour
   ☐ 1 to 2 hours
   ☐ 3 to 4 hours
   ☐ More than 4 hours

18. On average, how many hours a day did you spend on extracurricular reading using electronic device(s)?
   ☐ Less than 1 hour
   ☐ 1 to 2 hours
   ☐ 3 to 4 hours
   ☐ More than 4 hours

19. On average, how frequent did you take breaks from your electronic device(s)?
    - ☐ Less than every hour
    - ☐ Every hour
    - ☐ Every 2 to 3 hours
    - ☐ Every 4 hours and above

20. Did you experienced eye pain after using electronic device(s)?
    - ☐ Yes
    - ☐ No

21. Did you experienced eye fatigue after using electronic device(s)?
    - ☐ Yes
    - ☐ No

22. Did you experienced headache after using electronic device(s)?
    - ☐ Yes
    - ☐ No

23. Did you experienced glaring after using electronic device(s)?
    - ☐ Yes
    - ☐ No

24. Did you experienced itchiness of eye after using electronic device(s)?
    - ☐ Yes
    - ☐ No

25. Did you experienced dry eye after using electronic device(s)?
    - ☐ Yes
    - ☐ No

26. Did you experienced blurred vision after using electronic device(s)?
    - ☐ Yes
    - ☐ No

27. Did you experienced double vision after using electronic device(s)?
    - ☐ Yes
    - ☐ No

SECTION C: DURING ONLINE CLASSES

Answer the following questions based on your experience during online classes: -

28. How frequent did you take breaks from your device(s) during online classes?
    - ☐ Less than every hour
    - ☐ Every hour
    - ☐ Every 2 to 3 hours
    - ☐ Every 4 hours and above

29. Did you experienced eye pain after using electronic device(s)?
    - ☐ Yes
    - ☐ No

30. Did you experienced eye fatigue after using electronic device(s)?
    - ☐ Yes
    - ☐ No

31. Did you experienced headache after using electronic device(s)?
    ☐ Yes
    ☐ No

32. Did you experienced glaring after using electronic device(s)?
    ☐ Yes
    ☐ No

33. Did you experienced itchiness of eye after using electronic device(s)?
    ☐ Yes
    ☐ No

34. Did you experienced dry eye after using electronic device(s)?
    ☐ Yes
    ☐ No

35. Did you experienced blurred vision after using electronic device(s)?
    ☐ Yes
    ☐ No

36. Did you experienced double vision after using electronic device(s)?
    ☐ Yes
    ☐ No