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MEASURING STUDENTS' EMOTION ON ONLINE LEARNING DURING COVID-19 PANDEMIC USING CONDITIONAL PROBABILITY APPROACH

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Abstract

The COVID-19 pandemic, which started at the end of 2019, caused a significant impact on all industries, including education sectors worldwide. In March 2020, the Malaysian government implemented the Movement Control Order (MCO), which closed all schools and higher education institutions due to the pandemic. This situation disrupted classes and activities at the institution; the only option available for students to resume learning was to go online. The sudden shift from offline and blended learning to online learning had an impact on students' participation as well as the emotion in the learning process. This study aims to evaluate the positive and negative emotions towards students' learning during the COVID-19 pandemic. It also aims to identify relationships between students' emotions and the demographic variables such as gender, Cumulative Grade Point Average (CGPA), socioeconomic status, and internet connection stability of students. Data were collected using a short version of the Achievement Emotions Questionnaire (AEQ-S) from Kolej Universiti Poly-Tech MARA (KUPTM) students who undergo mathematics or statistics class during the April 2021 academic session. The data were then analyzed using conditional probability and the Pareto analysis approach. The findings showed that students have positive emotions (pride and enjoyment) towards online learning with 79.3% and 81.7%, respectively. The percentages of negative emotions (boredom, anger, hopelessness, and anxiety) towards online learning are 7.3%, 7.3%, 12.2%, and 42.7%, respectively. These findings demonstrated a high level of students' positive emotions towards online classes during the COVID-19 pandemic.

Keywords: Emotion, online learning, COVID-19

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1. Introduction

The first epidemic of novel coronavirus disease 2019 (COVID-19) occurred in December 2019 in Wuhan, China, and spread to other world areas in early 2020. World Health Organization (WHO) announced the novel coronavirus outbreak as a Public Health Emergency of International Concern due to the globally widespread. In early March 2020, it was declared as a pandemic (World Health Organization, 2020). The first COVID-19 case reported in Malaysia was on 25 January 2020 (Elengoe, 2020). COVID-19 cases in Malaysia shows an alarming level of spread and severity which led the government to impose the nationwide lockdown known as Movement Control Order (MCO) under the Control of the Spread of Infectious Diseases Act 1988 and the Police Act 1967 (Bunyan, 2020; Tang, 2020) to curb the spread of the disease.

All government and private premises are to be closed, and all operations are to cease together with all places of learning, from kindergartens to higher education institutions. Only essential services such as utilities, telecommunications, transport, banking, health, and others are open during MCO (Bunyan, 2020; Tang, 2020) with strict Standard Operating Procedure. The Higher Education Institutions (HEIs) are one of the sectors most affected by the enforcement of the MCO. Teaching and learning activities need to be implemented online to replace the face-to-face method that was commonly practiced before (Menon, 2020).

1.1. Online Learning

According to Dhawan (2020), online learning can be defined as learning experiences in synchronous or asynchronous contexts using various devices such as smartphones, computers, laptops, tablets, and netbooks with the presence of internet access. Online learning that takes place at the same time for multiple students is known as synchronous learning. Student-lecturer interaction will occur in real-time at specific virtual locations. Live webinars, video conferencing, virtual classrooms, and instant messaging are examples of synchronous online learning techniques. At the same time, asynchronous online learning allows students to study at their own pace. Learning content is not provided in live lectures; instead, it is available through various learning systems and forums. Lecturers will provide materials such as notes, tests, and assignments that can be accessed at any time frame given by their lecturer.

Students around the globe are affected by the pandemic in various areas of their life, but mainly due to the closing of campuses and face-to-face teaching being replaced by online formats, reduction or elimination of social contacts, and cultural activities. However, there is no choice but to move immediately to the online mode of delivery. The sudden transition from the face-to-face to online mode has a significant impact on students' engagement, participation, and emotion in the process of learning (Baltà-Salvador et al., 2021; Kamal et al., 2020; Mirahmadizadeh et al., 2020; Oraif & Elyas, 2021). Recent evidence suggests that face-to-face communication is the most emotionally engaging (Bhansali & Sharma, 2019). Students enrolled in online courses show a significantly higher technology-related fear, anger, and helplessness (Butz et al., 2014). In addition, the limited social exchange resulting from the COVID-19 pandemic may also foster negative emotions. There is

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evidence that social isolation can trigger stress-related emotions and reduce well-being (Beaunoyer et al., 2020).

One of the significant challenges to online learning is internet connection stability (Allam et al., 2020; Amir et al., 2020; Cahyadi et al., 2021; Chung & Mathew, 2020). A stable internet connection is vital to ensure the success of online learning activities. At the same time, it may motivate students to focus during classes, leading to higher academic performance levels (Alsmadi et al., 2021). Currently, internet access has become a basic need for society as well as students. To ensure that nobody is left behind, the Malaysian government has introduced several incentives under the National Economic Recovery Plan (PENJANA) and National Digital Network Plan (JENDELA) to bridge the digital gap among communities. The incentives include free internet data of 1 gigabyte (1GB) for all users, upgrading broadband services nationwide, and expedite the provision of 5G infrastructure (Yeoh, 2020; Zainul, 2021).

1.2. Emotion

Emotion is one of the issues that many researchers have discussed. Emotion is defined as a conscious mental reaction (such as anger or fear) subjectively experienced as a strong feeling usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body. Numerous research in different fields has demonstrated that emotions play an essential role in the learning process (Espino et al., 2021; King & Chen, 2019; Rabiega-Wiśniewska, 2021; Stephan et al., 2019). King and Chen (2019) stated that emotions stimulate learners' attention and trigger the learning process. They affect what is learned and what is retained. Ghaderizefreh and Hoover (2018) claimed that academic emotion is one of the factors that may influence students' academic performance.

Students and instructors both experience a range of emotions, from the positive side, such as enjoyment, to the negative side, such as anger. According to Tempelaar et al. (2012), these emotions appear to moderately strongly affect a student's preference for online learning. Shahriarirad et al. (2021) discovered that the COVID-19 pandemic might cause psychological problems among students due to the transformation of traditional methods to online learning. Positive emotions of students were present in half of the respondents in the study conducted by Espino et al. (2021). In contrast, negative emotions were present in more than three-quarters of the respondents. A survey by Mirahmadizadeh et al. (2020) revealed a satisfactory degree of students' emotions toward schools. This survey shows that students were eager about learning and schools despite the difficult circumstances during the closing of schools due to the pandemic COVID-19.

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1.3. Achievement Emotion Questionnaire

On top of that, in measuring the students' emotions, the Achievement Emotions Questionnaire (AEQ) has been used widely in educational research and beyond (Bieleke et al., 2021). The emotions can be divided into positive and negative emotions. Positive emotions include pride, hope, and enjoyment, whereas negative ones are anger, anxiety, hopelessness, shame, and boredom (Mirahmadizadeh et al., 2020). In addition, Bieleke et al. (2021) suggested that the AEQ is a well-established tool for evaluating achievement emotions in educational research. Hence, they developed a short version of AEQ that is AEQ-S which is suitable for use when administration time is restricted. Similarly, Bhansali & Sharma (2020) and Mirahmadizadeh et al. (2020) used AEQ to evaluate students' emotions and attitudes towards the sudden closure of schools during the COVID-19 pandemic. Furthermore, AEQ has been used widely in a variety of subjects such as Mathematics (Moreira et al., 2019), Physics (Bhansali & Sharma, 2020), Physical Education (Fierro-Suero et al., 2020). It has been translated into different languages such as German, Arabic, Filipino, Korean, and Portuguese (Molfenter, 1999; Titz, 2001; Ismail, 2015; King, 2010; Kim & Lee, 2014 and Peixoto et al., 2015 as cited in (Sánchez Rosas, 2015).

2. Problem Statement

- The COVID-19 pandemic significantly impacts mental health (Maladkar and Tekchandani, 2021), including students' emotions. Many scholars have conducted research that focuses on online learning during the pandemic. The study was conducted to focus on students' readiness for online learning (Chung et al., 2020), attitude and perception of online learning (Muthuprasad et al., 2021), online learning satisfaction (Chung and Mathew, 2020), and online learning implementation (Madya and Abdurahman, 2020).
- There is a lack of research that focuses on students' emotions on online learning. Hence, this research aims to evaluate the positive and negative emotions towards students' learning during the COVID-19 pandemic.

3. Research Questions

- Do students have positive emotions about online learning?
- Do students have negative emotions about online learning?
- Is there any relationship between positive emotion and demographic characteristics?
- Is there any relationship between negative emotion and demographic characteristics?

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4. Purpose of the Study

The objective of this study is to evaluate the positive and negative emotions towards students' learning during the COVID-19 pandemic. It also aims to identify relationships between students' emotions and the demographic variables such as gender, Cumulative Grade Point Average (CGPA), socioeconomic status, and internet connection stability of students**.**

5. Research Methods

Data were collected using a self-administered questionnaire which was distributed to 82 KUPTM students who took Mathematics or Statistics subjects during the academic session April 2021. A short version of the Achievement Emotions Questionnaire (AEQ-S) which is adopted from Bieleke et al. (2021), is used in this study. The AEQ-S contains 24 items assessing the six trait emotions: enjoyment, pride, anger, anxiety, hopelessness, and boredom. The items address emotional experiences that occurred before, during, and after attending the online classes. Each item is assessed using a ten-point Likert scale ranging from (1) strongly disagree to (10) strongly agree. The responses were then recoded into two (2) categories; disagree and agree. Responses from 1 to 5 were grouped under 'disagree,' while 6 to 10 were categorized as 'agree.' Data will then be analysed using conditional probability and the Pareto analysis approach. Data analysis encompasses descriptive statistics using IBM Statistical Package for Social Sciences (SPSS) version 26.0.

6. Findings

In this study, the emotions are categorized into two (2) categories; positive and negative emotions. Positive emotions include pride and enjoyment, while negative emotions are hopelessness, anxiety, boredom, and anger. Based on the responses, it is found that 65 and 67 out of 82 students have pride (79.3%) and enjoy (81.7%) online learning, respectively. For negative emotions, 72 students felt that they were not hopeless (87.8%), while 76 felt not bored and angry (92.7%) when joining online classes. However, there was a slight difference in anxiety emotion as it shows 47 out of 82 students (57.3%) felt anxiety when joining online classes while 35 of them did not.

Table 1 presents a conditional probability for each positive and negative emotion based on gender and household income. The computational conditional probability of Table 1 involves the joint probability distribution between two events; gender and emotion (pride, enjoyment, hopelessness, anger, and anxiety) and household income and emotion, respectively. Generally, the joint probability distribution for 'gender' given 'emotion' is calculated as follows:

$$\boldsymbol{P(\ Gender \mid Emotion)} = \frac{\boldsymbol{P(Gender\ \cap Emotion)}}{\boldsymbol{P(Emotion)}}$$

For example, the following formula is used to calculate the $\boldsymbol{P(Male \mid Pride)}$:

$$\boldsymbol{P(\ Male \mid Pride)} = \frac{\boldsymbol{P(Male\ \cap Pride)}}{\boldsymbol{P(Pride)}}$$

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$$P(Male \mid Pride) = \frac{\frac{27}{82}}{\frac{65}{82}} = 0.415$$

The complete conditional probability for emotions based on gender and household income is presented in Table 1. In contrast, the conditional probability for emotions based on Cumulative Grade Point Average (CGPA) and internet connection stability is presented in Table 2.

Table 1. Conditional probability between emotions based on gender and household income

Emotions		Gender		Household income					
		Male	Female	RM2000 and below	RM2001 - RM4000	RM4001 - RM6000	RM6001 - RM8000	RM8001 - RM10000	RM10001 and above
Positive	Pride	0.415	0.585	0.448	0.253	0.092	0.069	0.084	0.054
	Enjoy	0.420	0.580	0.428	0.279	0.082	0.074	0.086	0.052
Negative	Hopeless	0.453	0.547	0.443	0.282	0.084	0.091	0.045	0.056
	Anxiety	0.508	0.492	0.450	0.312	0.079	0.079	0.021	0.058
	Boredom	0.465	0.535	0.439	0.264	0.092	0.092	0.063	0.050
	Anger	0.446	0.554	0.449	0.259	0.089	0.092	0.059	0.052

Generally, female students show a slightly higher response in pride and enjoyment with 58.5% and 58% each (Table 1). Similar results are also found from negative emotion, which consists of not hopelessness (54.7%), not boredom (53.5%), and not anger (55.4%). Meanwhile, there are pretty similar scores between not anxiety for males (50.8%) and female students (49.2%). However, the differences in emotion scores between genders are minimal (about 1% to 17%). The results obtained contradict a study conducted by Mirahmadizadeh et al. (2020) and Reilly & Rosas (2019). They found that gender was not a significant element to the emotions in the study they conducted. However, Sanches et al. (2020) found a significant difference in anxiety and enjoyment between gender, but with minor to moderate effects.

In terms of household income (Table 1), most of the students were from families with income RM4000 and below, which can be categorized as B40. According to the Household Income & Basic Amenities Survey Report 2019, which was released by The Department of Statistics Malaysia (DOSM), B40 represents the bottom 40% of income earners who earn less than RM4850 per month. Since the majority of the students come from household incomes less than RM4000, it can be seen from the result that most responses fall under the B40 group. 70.1% of the students felt pride, while 70.7% enjoyed attending online classes. At the same time, they were not hopeless (72.5%), not bored (70.3%), not angry (70.8%), and did not have anxiety (76.2%) when joining the classes. In conclusion, students were happily attending their online classes despite their social-economic status background. The result is contrary to Faez et al. (2020), who found that students with a lower family income tend to have a high level of anxiety compared to the higher income.

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Table 2. Conditional probability between emotions based on CGPA and internet connection stability

Emotions		CGPA				Internet Connection Stability		
		2.00 - 2.19	2.20 - 2.99	3.00 - 3.66	3.67 - 4.00	Least stable	Neutral	Stable
Positive	Pride	0.011	0.054	0.379	0.556	0.146	0.437	0.418
	Enjoy	0.015	0.056	0.375	0.554	0.156	0.401	0.442
Negative	Hopeless	0.014	0.028	0.439	0.519	0.164	0.474	0.362
	Anxiety	0.005	0.011	0.460	0.524	0.190	0.503	0.307
	Boredom	0.010	0.050	0.426	0.515	0.172	0.462	0.366
	Anger	0.010	0.043	0.439	0.508	0.161	0.456	0.384

In academic performance, 50% of respondents came from students whose CGPA is greater than 3.67, while 43.9% were students with CGPA between 3.00 to 3.66. From Table 2, it was shown that more than 55% of students with CGPA greater than 3.67 satisfied and enjoyed attending online classes. In addition, the same group of students was not hopeless (51.9%), did not have anxiety (52.4%), not bored (51.5%), and not angry (50.8%). In contrast, only 1.15% and 7.1% of students with CGPA less than 3.00 felt pride and enjoyed attending online classes. At the same time, 4.2% were not hopeless, did not have anxiety (1.6%), were not bored (6.0%), and were not angry (5.3%) while attending their online classes. Therefore, it is more likely that students' CGPA did not impact students' emotions. As a result, all groups of students possess good emotions towards online classes. The result contradicts Mirahmadizadeh et al. (2020), who stated that students' Grade Point Average (GPA) demonstrated a robust positive association between students' attitudes toward school and learning. As the GPAs of students increase, the positive emotions of students will also increase.

In this study, the ratio of students using laptops, smartphones, and either tablet or desktop are 7:2:1. Apart from that, 51.2% of students used mobile data for internet connection and 42.7% subscribed to home plans from local telecommunication companies. Table 2 depicts that 39% of the students have a stable internet connection, while only 17.1% face problems with their connections. It is clearly shown that 41.8% of students with stable internet connections are proud, while 44.2% enjoy attending online classes. On the other hand, the same group shows that 36.2% were not hopeless, 30.7% were not anxious, 36.6% were not bored, and 38.4% were not angry. From this result, it can be interpreted that the students were relatively happy attending online classes if their internet connection was stable. The result aligns with Chung and Mathew (2020), who found that internet connection is significantly correlated with online learning satisfaction. At the same time, Faez et al. (2020), in their research, confirmed that the anxiety level was lower in students with stable internet connections and vice versa. At the same time, a study was done by Rabiega-Wiśniewska (2021) in Poland concluded that about 90% of respondents had practically no issues with maintaining a stable internet connection and were doing well online learning.

The next step is to compute the emotional score by sorting the probability value in descending order, and then all of the values are converted into percentages. Table 3 and Table 4 show pride, based on household income and anxiety on internet connection stability.

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Table 3. Result of emotion (pride) for income

Income	Pride	Pride (%)	Cumulative (%)
RM2000 and below	0.448	44.83	44.83
RM2001 - RM4000	0.253	25.29	70.11
RM4001 - RM6000	0.092	9.20	79.31
RM8001 - RM10000	0.084	8.43	94.64
RM6001 - RM8000	0.069	6.90	86.21
RM10001 and above	0.054	5.36	100.00

Table 4. Result of emotion (enjoyment) for internet connection stability

Connection	Enjoy	Enjoy (%)	Cumulative (%)
Stable	0.442	44.24	44.24
Neutral	0.401	40.15	84.39
Least stable	0.156	15.61	100.00

Pareto principle analysis (named after Vilfredo Pareto, 1848-1923) uses the 80/20 principle, which means 20% of causes can produce 80% of results. In the quality control approach, a large majority (80%) of problems are produced by a few (20%) essential effects (Harvey & Sotardi, 2018). In this research context, the students with household income below RM6000 were the highest group (79.3%) proud of attending online classes (Table 3). Using the same technique of the Pareto chart, Figure 2 and Figure 4 are drawn for hopelessness versus household and anxiety versus internet connection stability. Based on cumulative percent (%) in Table 3 and Table 4, the Pareto chart for pride (Figure 1) and enjoyment (Figure 3) are drawn, respectively.

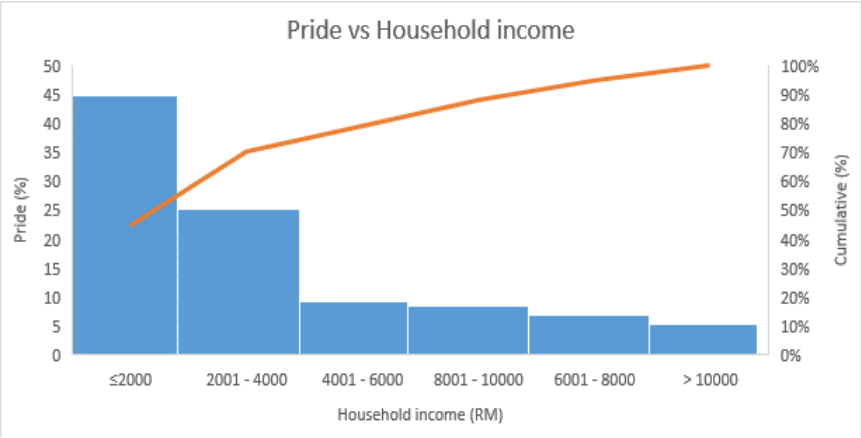

Figure 1. Pareto chart of pride and household income

Figure 1 shows the Pareto chart of positive emotion, specifically for pride. It is shown that the highest group of students who have this positive emotion comes from the B1 cluster of the B40 group, which is household income less than RM2000 with a probability of 44.8%. According to the Household Income and Basic Amenities Survey Report (2019), the B1 cluster of the B40 refers to an income threshold less than RM2500. The second highest group are students from household income between RM2001 to RM4000 (25.3%), followed by RM4001 to RM6000 (9.2%). Surprisingly, the students with parents'

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income of RM8001 to RM10000 showed a higher probability of pride emotion, 8.4%, compared to those with parents' income between RM6001 to RM8000 per month (6.9%).

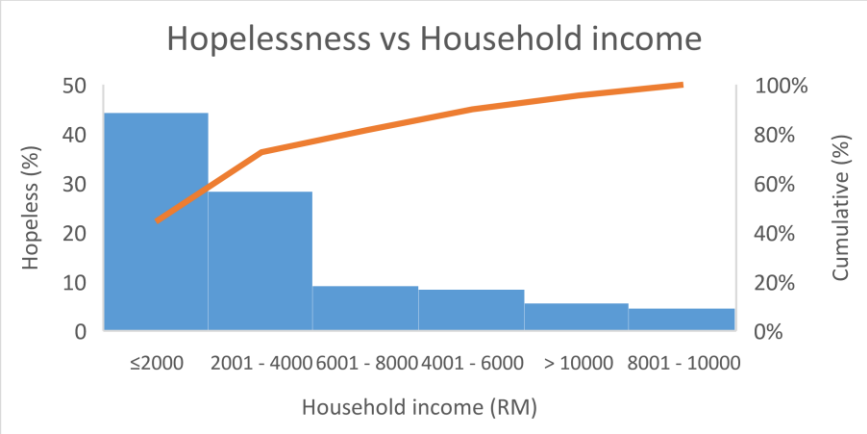

Figure 2. Pareto chart of hopelessness and household income

Figure 2 shows similar results for the highest group of students who have negative emotions for hopelessness. The highest group are students whose parent's income is less than RM2000 (44.3%), followed by RM2001 to RM4000 (28.2%) and income between RM6001 to RM8000 (9.1%). The students whose parents' income of RM8001 to RM10000 show that they have the lowest probability of having hopeless emotion, which is only 4.5% compared to the students from the T20 group (5.6%), which refers to an income threshold greater than RM10960 (Department of Statistics Malaysia, 2020).

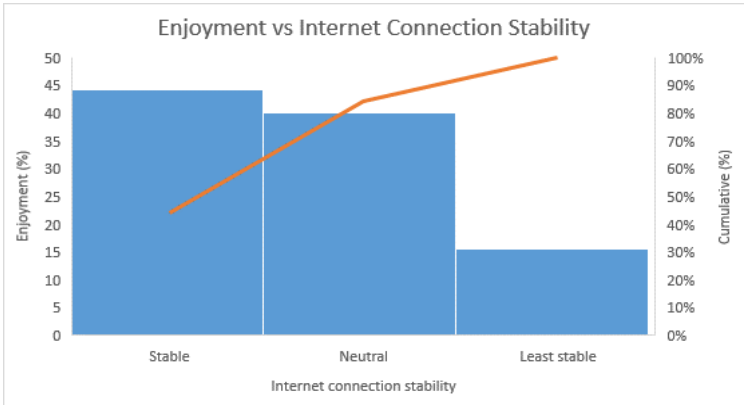

Figure 3. Pareto chart of enjoyment and internet connection stability

Figure 3 shows an interesting finding where students who have stable internet connectivity enjoy attending online classes with a probability value of 44.2%. As expected, those with the least stable connection (15.6%) feel less enjoyment in joining the classes. The result shows that internet connection is one of the factors that significantly impact students' emotions. This result aligns with Chung and Mathew (2020), who found that students with stable internet connections are more satisfied with online learning. Muthuprasad et al. (2021) added that appropriate content, connectivity, and recorded videos make online classes parallel to face-to-face learning.

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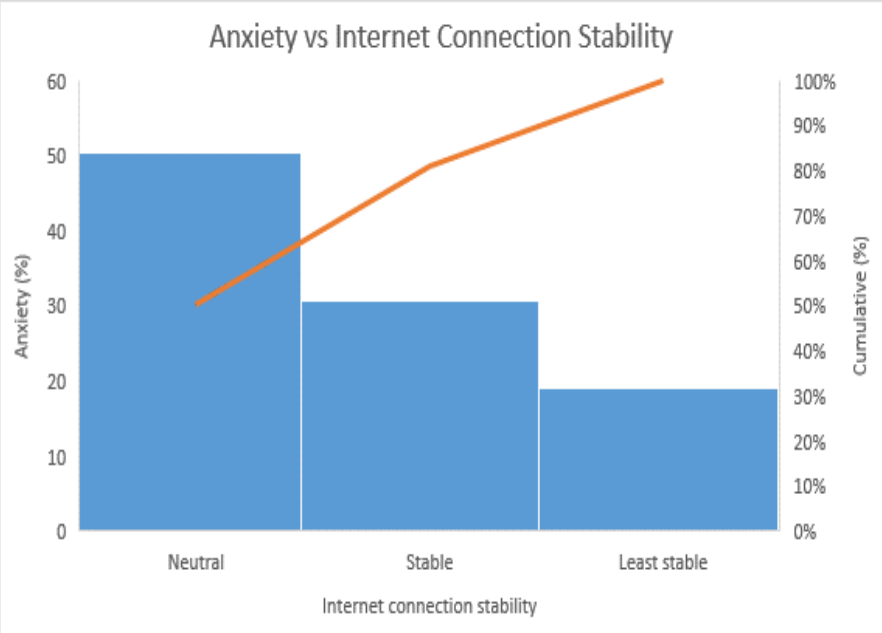

Figure 4. Pareto chart of anxiety and internet connection stability

Based on the responses given by students, the highest group of students have neutral internet connection stability, which shows that their internet connection might be stable or sometimes might be not (Figure 4). On the other hand, students who have a stable internet connection have less anxiety (30.7%) compared to those facing the least stable connection (19.1%). The result is similar to Faez et al. (2020), who confirmed that the anxiety levels are higher in students with poor internet connection.

7. Conclusion

The findings demonstrated the students have pride and enjoyed online classes for April 2021 academic session. At the same time, they did not feel hopeless, bored, and angry and did not have anxiety when joining the classes. There is an association between positive and negative emotion, with females revealed a slightly higher probability than males except for anxiety. The anxiety score for males is somewhat higher than females. However, there is no relationship between positive and negative emotions with students' social-economic status background and CGPA. In terms of devices used, most of the students join online classes using laptops, and the rest are using either smartphones, tablets, or desktops. This study proved that there is a relationship between the internet connection and students' emotions. Students were proud, enjoy, not hopeless, not bored, not angry, and did not have anxiety if the internet connection was stable.

7.1. Limitation and Recommendation

There are several limitations in this study that could be explored further in future research. Firstly, only 82 students were involved in this study, taken from mathematics and statistics classes during the academic session April 2021. Non-probability sampling method was used; therefore, the sample is not random. More respondents will be involved in future research, and an appropriate

probability sampling method will be used. This is important to ensure that the findings can be generalised to the enormous scope of students in KUPTM.

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