Attitudes Towards Online Learning During COVID-19: A Cluster and Sentiment Analyses

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Abstract. This paper investigated the attitudes of 702 college students toward the implementation of fully online learning during the COVID-19 pandemic. Toward this goal, responses of the students were collected and analyzed through hierarchical cluster and sentiment analyses using the R software. Hierarchical cluster analysis revealed hopeful and apprehensive attitudes toward online learning. Advantages of online learning emerged as positive sentiments while challenges and their impact on mental health emerged as negative sentiments. It is concluded that online learning is a promising platform of learning provided that its shortcomings are addressed. Implications to teaching are offered.

Keywords. Apprehension, College Students, Internet, Mental Health

1. Introduction

The coronavirus disease (COVID-19) becomes a catalyst to implement full online learning in higher education institutions (HEIs) [1]. Despite the inherent limitations of online learning (e.g., the complexity of course materials, technical issues [2-3], distractions, domestic problems [4], ineffective skill acquisition [5]), HEIs shifted to fully online learning as an emergency response to teaching due to ongoing community lockdown [1]. Before the pandemic, students were accustomed to face-to-face learning settings, and teacher-centered approaches may still be common. On the other hand, fully online learning is a combination of teachers' lecture sessions (i.e., synchronous sessions through cloud-based conferencing applications like Zoom and Google Meet) and independent learning (i.e., asynchronous learning). In an asynchronous session, learners are expected to learn the course content at their own time within a specific timeframe [6].

The sudden shift in educational platforms, as well as the mental distress brought on by COVID-19, may trigger different student attitudes to online learning [7]. Attitudes can influence students' learning outcomes [1]. However, it is still unclear how college students perceived full online learning as an emergency platform of learning in the context of the COVID-19 pandemic. Hence, it is imperative to understand the attitudes of students towards full online learning during the COVID-19 pandemic. Understanding the attitudes towards online learning as an emergency teaching response is important

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since it may serve as a basis for the development of appropriate online pedagogies and policies. Toward this goal, cluster and sentiment analyses were employed to describe the attitudes of the students. Specifically, the study intends to answer the following questions. 1) What are the attitudes of the students towards full online learning when analyzed using cluster analysis? 2) How can we describe the sentiments of the students towards full online learning?

2. Literature review

2.1. Attitudes towards online learning

Previous studies reported consistent findings regarding the attitudes of college students towards online learning during COVID-19 [8-11]. Students agreed that online learning is a safe way to learn during the COVID-19 pandemic [11-12]. Online learning enabled the students to participate more in class discussions [11]. Students favored online learning over face-to-face learning because there is no commuting and lesser preparation time [2, 11]. As such, students had more time to spend with their families and engage in new activities or hobbies [9]. Online learning can also save on transportation and per diem costs [8]. Hence, it was concluded that online learning is more cost- and time-effective [11].

Meanwhile, the negative aspects of online learning were also reported. In general, students perceived that online learning is difficult [9]. There are varying reasons for this perception. One reason is the attitude of unwillingness to learn online [10]. Students believed that face-to-face is still a better learning modality than online learning [7, 12]. Environmental and situational barriers including noise, distraction, and workload [9, 11] contributed to this attitude. Economic, technical, and Internet access barriers hinder the students' positive online experience [7, 10-11]. Finally, online learning caused psychological and emotional stress to the students [9-10]. Students were anxious about submission deadlines [3].

2.2. Cluster analysis

Various studies utilized hierarchical cluster analysis to analyze the students' attitudes towards different subject domains. For example, one study demonstrated the use of hierarchical cluster analysis to understand the risk-reduction counseling and perceptions of changes in risk behavior of 35 male participants [13]. Their analysis of the qualitative data yielded three themes: rapport (i.e., comfortable discussing sexual and risk-reduction behaviors), balancing risks (i.e., not disclosing risky or unconventional sexual practices), and risk homeostasis (i.e., sexual behavior was already well-established before the interview).

The study Riley et al. [14] investigated the dental attitudes of 837 participants in the Florida Dental Care Study. Participants' attitudes were divided into four groups: positive attitudes toward dental care, frustrated believers toward dental care, negative attitudes and cost concerns, and pessimistic attitudes toward personal and professional oral care. In another study, Bringula et al. [15] employed hierarchical and sentiment analysis on the textual feedback on YouTube programming tutorial videos. It was shown that YouTube users provide positive feedback and tend to appreciate the content of the videos.

2.3. Sentiment analysis

Sentiment analysis is the "field of study where it analyzes people's opinions, sentiments, evaluations, appraisals, attitudes, and emotions towards entities" [16, p.7]. The field of education leverage its capabilities to understand the sentiments of students in online learning. Ortigosa et al. [17] collected students' textual feedback on Facebook and then utilized the results to make online e-learning adaptive to the students' sentiments. For example, an emotional state detector can be incorporated in the e-learning system and motivational tasks may be provided when a negative state is detected. In a similar study, Rani and Kumar [18] employed sentiment analysis to analyze comments from both course surveys and online sources to improve teaching and learning in an online environment. They concluded that their system capable of analyzing students' sentiments has a great potential to improve the teaching and learning practices in universities. The results of sentiment analysis could inform administrators and teachers about the sentiments, emotions, and satisfaction of the students and corrective actions could be taken to meet the educational needs of the students.

The same method was employed for the improvement of blended learning [19]. The authors [19] gathered the student evaluations on the 18 blended learning courses in one university in the Philippines. The study identified one course with the most negative sentiment. The authors proposed action plans to improve the course so that it could be retained in the blended learning program.

Sentiments are not only limited to positive, negative, or neutral classifications [20]. The authors [20] offered a multi-dimensional sentiment of classifications. They added the insightful, angry, and joke classifications into the existing three conventional dimensions (e.g., positive, negative, and neutral). The purpose of this multi-dimensional classification is to capture the overall students' feedback in online learning courses, especially deemed to be useful for massive open online courses.

Recently, sentiment analysis was employed to determine the public opinion towards the implementation of online learning during the COVID-19 pandemic. Analysis of opinions from online news and blogging sites revealed highly positive reviews (90%) of online learning during COVID-19 [21]. However, Sahir et al. [22] had different research finding. They found that the majority (74%) of the tweets of Indonesian people were classified as negative sentiments indicating that the public was not receptive to online learning. Moreover, the words "stress" and "covid" were the most occurring words from the people's tweets.

3. Methodology

3.1. Participants, research locale, sample size, and sampling design

This study was conducted in one university in Manila, Philippines. There were 6,866 students enrolled in online classes. A sample size of 367 was computed using a Raosoft online sample size calculator [23]. This sample size was distributed proportionately based on the students' population of the six colleges of the university. Participants were selected through their class sections. The sample size per college was then divided by 40 students (average class size) to determine the number of classes. Afterward, all class sections were requested from the six colleges. Then, the class sections were written on a piece of paper and were randomly picked out. Eighteen class sections were selected with

a total of 720 students. A total of 702 students participated in the study with an average age of 20 years old (SD = 1.7). There were more female participants (n = 377, 54%) than male participants (n = 325, 46%).

3.2. Research instrument, data collection procedure, data cleaning, and data preprocessing

A validated research instrument was distributed through the official learning management system (LMS) of the university. The research instrument was adopted from [4]. Students answered an open-ended question about their views on fully online learning during COVID-19. Google Form was used to distribute the survey form. All responses were saved in a spreadsheet. The collected responses comprised the dataset of the study. The dataset was then subjected to data cleaning and data preprocessing [15]. In data cleaning, all special characters were removed. In data preprocessing, stopwords (e.g., "the", "a", "an", etc.), keyword terms (e.g., "online", "COVID-19", "perception", etc.), and noise words (e.g., alphanumeric, whitespace, punctuations, and unrecognizable characters) were removed in the dataset. Afterward, all words in the dataset were transformed into lowercase. Next, the dataset was subjected to word lemmatization. Finally, the words were then tokenized which finally formed the corpus. The corpus contained 1450 words.

3.3. Data analysis

Hierarchical clustering and sentiment analyses were employed to analyze the corpus [15]. Hierarchical cluster analysis was utilized to determine whether there are clusters of students' attitudes towards online learning. There are two reasons why the hierarchical analysis was employed in this study. First, hierarchical cluster analysis is suitable to this study because the number of clusters cannot be determined at the onset of the analysis [24]. Second, hierarchical analysis performs well in analyzing when analyzing qualitative data [13]. Sentiment analysis was employed because it is capable to determine whether opinions, sentiments, appraisals, emotions, and attitudes are positive, negative, or neutral [16].

   The analyses were employed using the R software. In cluster analysis, words that appeared less than 1% in the dataset were removed in the corpus. This step yielded 26 words. The clusters were then labeled based on the actual responses of the students. The elbow method was used to determine the number of clusters to retain. The sentiments were based on the *bing* sentiments classifications (i.e., positive and negative).

4. Results and discussion

Table 1 shows the top 10 most frequent words in the corpus. The words "learn" and "class" are the most occurring words. This finding is expected because of the context of the study. The third up to the tenth frequently occurring words confirm that students are facing challenges in the new online platform. The primary sources of these challenges are Internet connections and teachers' voluminous course requirements.

   As shown in Figure 1, the corpus can be grouped into two clusters. Hierarchical cluster analysis shows the groups of related words (Figure 2). For better interpretations, the clusters were converted to tables. The first cluster is composed of 23 words. In the

first cluster, the responses of the students signify that they are not totally against the implementation of online learning. These are shown in the narratives of three students. The second student [S2] commented that "*it [online learning] is good that all materials are already accessible but difficult to understand on my own.*" This narrative shows the advantage and disadvantages of online learning. This finding is consistent with the study of Bringula et al. [3] that understanding online materials is one of the challenges of online learning.

Table 1. Top 10 Most Frequently Occurring Words.

| Rank	Word	Frequency (Percentage)	Sample Sentence
1	Learn	347 (23.9%)	Online learning is an okay way for learning but I would still prefer face-to-face (f2f).
2	Class	227 (15.7%)	I prefer f2f classes.
3	Hard	168 (11.6%)	An online class is really hard.
4	Time	130 (9%)	I'm having a hard time coping with online classes.
5	Good	118 (8.1%)	It is hard to focus since not all homes can be a good environment for studying.
6	Internet	72 (5%)	It is difficult to study online learning because sometimes our internet is unstable.
7	Professor	67 (4.6%)	If we send messages to professors, I hope they reply to us even if they would disagree/decline our requests.
8	Give	63 (4.3%)	I hope they would give us more time for submissions because we do not just sleep, eat, and get on to our computers; we have a lot of chores as well.
9	Need	60 (4.1%)	We need face-to-face classes because we need to gain more experience and hands-on activities.
10	Difficult	56 (3.9%)	It is difficult to study online learning because sometimes our internet is unstable.
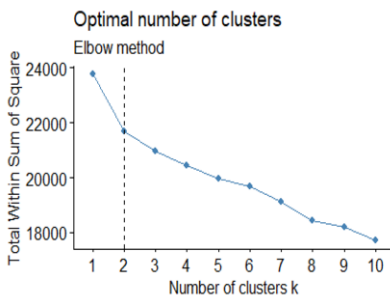
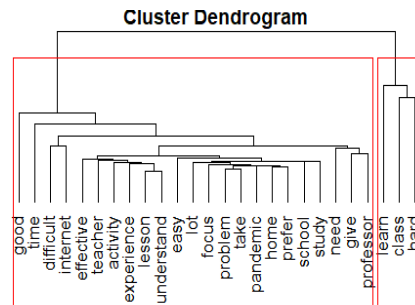**Figure 1.** Optimal Clusters using the Elbow Method.

Figure 2. Hierarchical Cluster Analysis of Attitudes towards Online Learning.

S1 agreed with S2. S1 further commented that online learning needs improvement. One of the cited improvements on the stability and accessibility of Internet connection [S3]. This finding is also reported in prior studies [3-4]. Teachers' balancing the quality and quantity of activities is another aspect of improvement (S6, S7). Students also request teachers to become more considerate and approachable (S4, S5). The cluster of these narratives citing the advantages and possible improvements to online learning practices is labeled as a "Hopeful" attitude.

The second cluster is composed of three words. The cluster of the words signifies the apprehensive feelings toward online learning. A student believed that they are not ready for this kind of learning (S8). Another student prefers face-to-face over online

learning (S10). This preference is attributed to the difficulty of acquiring skills through an online platform (S9). This finding is consistent with the study of Paechter and Maier [5]. This current study found two opposing attitudes toward online learning (Figure 3). Some students are open-minded on the implementation of online learning. To achieve full acceptance, students sought enhancements in online learning pedagogy and technological (e.g., Internet connection) support. On one hand, some students feel unprepared and prefer face-to-face classes. This preference is justifiable since some courses need the face-to-face presence of teachers (e.g., Dentistry courses) [2].
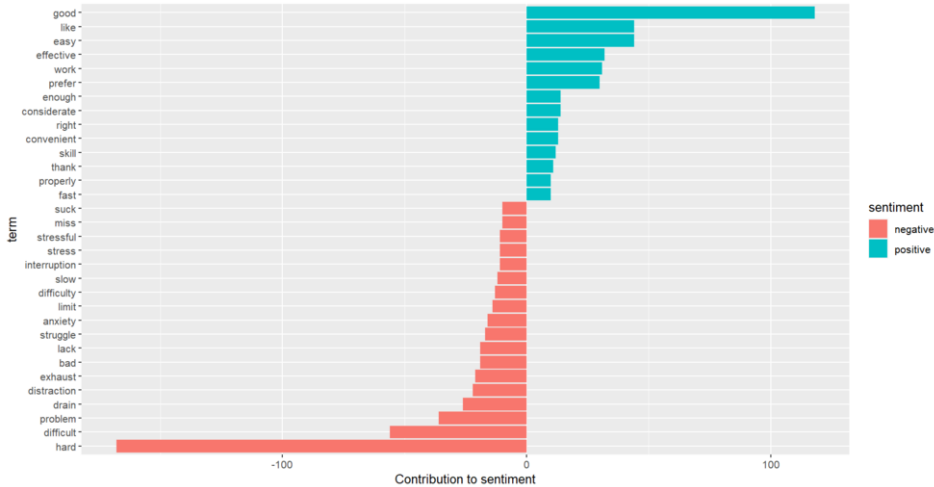

Figure 3. Result of Sentiment Analysis on the Attitudes of the Students toward Online Learning.

At the same time, there are more negative sentiments than positive sentiments in students' narratives about online learning. The words "*good*", "*like*", and "*easy*" are the dominating words indicating the positive outlook toward online learning. The positive sentiment reflects the convenience of online learning. For example, one student commented that it is more convenient to attend online classes than face-to-face since the former eliminates commute time. Bringula [2] and Hussein et al. [11] have the same research findings.

Table 2. Result of Cluster Analysis on the Attitudes toward Online Learning.

Attitudes	Words	Sample texts
Cluster 1 – Hopeful	good, time, difficult, internet, effective, teacher, activity, experience, lesson, understand, easy, lot, focus, problem, take, pandemic, home, prefer, school, study, need, give, professor	• Online learning is good but it needs improvements. [S1] • It is good that all materials are already accessible but difficult to understand on my own. [S2] • Online learning will be good if all have access to the Internet. [S3] • Almost all of my professors are not approachable. [S4] • The professor needs to be more understanding. [S5] • Professors give us a lot of activities and exercises thinking that we have so much free time at home. [S6] • The voluminous activities do not give us free time for our family. [S7]
Cluster 2 – Apprehensive	learn, class, hard	• We are not ready for this kind of learning. [S8] • Online learning is hard, especially for courses that require gaining practical skills. [S9] • In my opinion, f2f classes are better than online classes. [S10]

Interestingly, the word "*hard*" and "*difficult*" are the leading negative sentiments. The negative sentiments reflect the impact of online learning on students' mental health (e.g., anxiety). Intermittent Internet connection, unresponsive teachers, and distractions may contribute to the struggles and exhaustion of the students. Currently, universities are implementing academic/health breaks to prevent study or work fatigue and to give students, faculty, and staff more time to spend with their families in this time of pandemic [3]. The positive and negative sentiments of the students further confirm the opposing attitudes of the students shown in Table 2.

5. Conclusions and recommendations

This study investigated the attitudes of 702 university students toward full online learning during COVID-19 as an emergency teaching response. Hierarchical cluster analysis disclosed students' hopeful and apprehensive attitudes toward online learning. Sentiment analysis showed that there are more negative sentiments than positive sentiments. Positive sentiments revealed the advantages of online learning over face-to-face while negative sentiments revealed the impact of the challenges of online learning on mental health. Thus, it can be concluded that online learning is a promising platform of learning during the COVID-19 pandemic and continuous pedagogical, administrative, and technological improvements are needed to achieve its full potential.

The results of the study offer pedagogical and administrative recommendations. In terms of pedagogical value, the findings of the study inform educators of the challenges students are facing in online learning. Teachers have to balance the quality and quantity of asynchronous activities. They must also be responsive to students' inquiries. Teachers are encouraged to provide feedback and consultation sessions to eliminate the negative affinity toward them. School administrators may formulate policies that will support the above-mentioned recommendations. The results of this study further strengthen the university's current academic/health break policy. Through continuous improvements of online pedagogies and quick issuance of relevant academic policies, students' online learning expectations may be fulfilled and apprehensions may be reduced. Lastly, a follow-up study may be conducted to determine the impact of the implementation of the recommendations on the attitudes of the students.

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