



Investigation of students perception of the online learning process during pandemic using statistical and data mining methods

Kaja Mohaideen D^{1*}, Fiaz Ahamed A² and Mohammed Nadeemullah N³

Abstract

Almost all the fields of the world suffered a tremendous crisis due to the covid 19 pandemic and especially the education sector faced a complete transformation into a digital and online form to serve the student community whereas the majority of students were not prepared for such transformation and struggled a lot. In this study, an attempt was made to investigate the perception of the students who have undergone the online learning process during pandemic. A questionnaire concerning various components of the online learning process was prepared and an online survey was conducted among college students of Chennai, India. Data of 317 valid respondents subjected to various statistical methods and k means clustering algorithm. The results explored that the mean ratings of all the components ranged between (3 to 3.6) out of 5 with a standard deviation of (0.98 to 1.28). Some demographic characteristics such as 'Income' and 'Gender' had a significant effect on the component 'Device and Network'. Further, the respondents are clustered into three groups of (154, 74, 89) students, independent of all the demographic characteristics, but significantly different with respect to all the components of the survey.

Keywords

Statistical methods, k-means clustering, students perception study, online learning process.

AMS Subject Classification

62D05, 62J10, 91C20, 62H30, 68T10.

^{1,2,3} PG Department of Mathematics, The New College, Chennai-600014, Tamil Nadu, India.

*Corresponding author: ¹ kajamohaideen@thenewcollege.edu.in;

Article History: Received 21 January 2021; Accepted 22 February 2021

©2021 MJM.

Contents

1	Introduction	690
2	Literature review	691
3	Methodology	691
3.1	Participants of the survey	691
3.2	Components of the Questionnaire	692
3.3	Statistical Analysis of the data	692
4	Results	692
4.1	Demographic Characteristics of the data	692
4.2	Analysis of descriptive statistics	692
4.3	Response for the research question Q1	693
4.4	Response for research question Q2	693
4.5	k-means clustering and Elbow method	694
5	Discussion and Conclusion	695
	References	696

1. Introduction

World Health Organization (WHO) declared the coronavirus outbreak 2019 (COVID-19) a pandemic on February 11, 2020 [1] that threatened millions of people and had a huge influence on their day-to-day lives across the globe. COVID-19 was first reported in China (Wuhan) from the day onwards, the human race has experienced enormous difficulties such as painful suffering of the disease, untimely sudden deaths of family members, and finally a complete lockdown. As a result of pandemic lockdown, thousands of people lost their jobs, many of the businesses lost and many companies permanently closed down due to the unprecedented financial crisis [2]. The educational sector is one of the fields in the world that was severely affected and experienced a terrific transformation during the lockdown period. Almost in all the countries, schools and universities have started to run all academic activities such as teaching-learning and assessment exercises online.

Especially in India, all the state governments across the

country have directed all educational institutions to close temporarily as a measure to contain the spread of the novel coronavirus from the second week of March 2020, which is a crucial time to the whole education sector of the country for conducting all board exams, university entrance exams, competitive tests and school – college admissions, all of them were severely affected. In fact, COVID-19 had its first effect on the education system and learning process, including teaching and evaluation methodologies. As a result, all educational institutions across India have embraced the digital teaching-learning process. Unfortunately, the majority of students were not prepared for this transformation. Though students had prior experience in digital learning, they faced unprecedented stress and challenges such as unavailability of quality devices, unaffordability of broadband internet network, social isolation, absence of physical activities, etc during this pandemic period.

The objective of this study to investigate the perception of the students studying in various higher educational institutions and colleges of Chennai on the whole online teaching-learning process what they have been through during the pandemic period. The following research questions were constructed to attain the objective of this study

Q1. Is there any significant change in the students' perception of the online learning experience of the pre-pandemic to the pandemic period?

Q2. Do the demographic characteristics of the respondents has any significant effect on their perception of the online learning process?

Q3. Can students be further categorized into groups with unique characteristics so that their requirements and challenges may be exclusively studied?

Necessary data was collected by conducting an online survey and subjected to various statistical procedures and tests such as T-test, ANOVA, Tukey's (HSD), Chi-square, and also the data were clustered using Elbow method and k-means algorithm. As a result, the answers to the above-stated research questions were unearthed and explored. In the rest of the paper, Section 2 is committed for literature review, Section 3 explains the methodology, Section 4 records the results, and Section 5 is dedicated to discussions and conclusions.

2. Literature review

Distance education, which started in the mid-eighteenth century, was developed to compensate for the shortcomings of conventional education. It progressed quickly from correspondence courses and tapes to the introduction of personal computers and the use of computer-based multimedia applications [3]. New technologies and strategies, such as e-learning, online classes, and teachers, are all helping to increase student satisfaction in distance education [4]. Since online education is not limited by geography, students can learn from the best teachers and attend prestigious institutions irrespective of the place they live in [5]. Many researchers around the world have established many advantages of digital learning such as stu-

dents with special needs have unrestricted access to learning [6] factors such as gender, race, and other physical characteristics may lead to disagreements between students, but online education mitigates these issues [7]. Students' well-being is aided by digital preparation and an online learning atmosphere rich in content [8]. Plenty of other advantages worth considering in the online learning process include improved accessibility, access to services regardless of place or time, and cost and air pollution reductions, such as carbon dioxide emissions from reduced traffic [9].

Since online teaching was not a common method of education in schools and universities before the pandemic, the majority of teachers and students had little or limited experience with it [10]. Kamali et.al. opined that the importance of online education in the general public interest is growing day by day whereas that in educational institutions is declining. They also accept that providing students with a suitable network environment was necessary to minimize the negative effects of online education, and they addressed online education from the perspective of students [11].

For both students and teachers, digital learning, like any other form of instruction, has benefits and drawbacks. Some of the disadvantages, such as internet connectivity issues, low internet service efficiency, and a lack of digital tools [12]. Biasutti M. stressed the aspects of satisfaction associated with the use of a collaborative e-learning module, such as teamwork, concept comparison, application accessibility, community planning, and workload management, among others [13]. Roca et al. looked at how happy people were with their online learning. The findings revealed that the user's understanding of the usefulness and efficiency of the course, the quality of the platform and website service, and the degree of anticipated achievement all played a role in their online learning satisfaction [14]. Hrastinski recorded a fact that "if we wanted to boost online learning, we needed to improve online learner participation"[15]. Richardson et al. established the rule that in online learning environments, social relationships and interactions are particularly essential for a positive learning experience (Richardson et al., 2017) [16]. Hutt et al. recorded the issue of delayed clarifications for students' doubts in the online or distance educational system as the original classroom students can clarify their doubts in person at the starting or end of each class. [17]. Vikas Gupta and Namita Jain agree that while online education cannot fully replace conventional education, it can supplement it by providing students and teachers with a more nuanced experience simultaneously, the presence of a hybrid educational model, in which the best online and offline approaches are used, will provide stakeholders with an optimal experience [18].

3. Methodology

3.1 Participants of the survey

On the whole 323 students studying in various colleges of Chennai, participated in the online survey conducted through Google forms to assess the online learning process what the



students have undergone for the past 8 months. It was informed that the purpose of the survey is for academic research and the participation is purely voluntary and also the identity of the participants was kept anonymous. The majority of the questions in the survey are designed to rate and quantify the acceptance or satisfaction level of each category or component relating to the online learning process with respect to the Likert scale of 1(= very less) to 5 (=very high). This methodology is adopted because the students of the present era are well experienced and trained in reviewing various products that they purchase, services they undergo, and movies they watch with respect to (1 to 5) star measurement, and hence it will make the process familiar and comfortable to the participants.

3.2 Components of the Questionnaire

After rigorous research on literature and studies of traditional and online teaching-learning processes, a questionnaire with six sections and 35 questions was prepared to analyze various components of the online learning process.

Section 1 records “demographic information” such as Gender, Age group, Degree Programme, and family yearly income.

Section 2 categorized into two parts, section 2a consist of two general questions to rate the students’ overall experience in the online learning process before and during the Covid 19 pandemic period. Section 2b possess three questions about “ Device and Network” to assess the quality of gadgets, web platform, and network connectivity utilized for online learning.

Section 3 is equipped with 10 questions that analyze various “Components of the teaching-learning process” such as methodology, understanding of syllabus, content and curriculum, interactions with the teacher and other classmates, and finally online assessment and evaluation systems.

Section 4 consists of eight questions to assess “Development in learning attitudes”, that is to measure the level of improvement in learning attitudes such as interest, understanding, regularity, focus, motivation, self-discipline, involvement, and effectiveness.

Section 5 has nine questions to assess “Accessibility, Happiness and Enjoyment” which rates the happiness, convenience, accessibility, and enjoyment of the students in the online learning process.

Final section 6 possess three questions to rate their “Preference for Online over Classroom learning” which is comparing the online learning process with the traditional (face to face) learning process.

3.3 Statistical Analysis of the data

After a thorough Investigation, 317 questionnaires out of 323 were selected for further analysis and the remaining 6 declared invalid. The open-source software R programming was considered for all the statistical data analysis purposes. Initially, the collected data subjected to examine the reliability of the questionnaire using the section-wise Cronbach’ α test (see table 2), and the results show that the internal consistency

level of each section of the questionnaire is greater than the minimum acceptable level 0.7 [19]. As explained in Bawa [20] t-test, the Analysis of variance (ANOVA), Tukey (HSD) test, Chi-Square test were used in different places to analyse the data with 0.05 as the level of significance. Further, the data were clustered using the Elbow method and k-means algorithm to unearth the answers for various research questions established in previous sections.

4. Results

4.1 Demographic Characteristics of the data

It can be inferred from Table 1 that, among 317 valid respondents of the survey, the majority of them were male 211 (66.6%) and 106 (33.4%) were females, 213 (67.2%) students were from the income level of ‘below 1 lakh’ and only 31 (10.1%) have more than 3 lakh yearly income, 178 (56.2%) of them were teenagers in (17 – 19) age group, 125 (39.4%) belong to (20 – 22) and only 14 (4.4%) in 23 and above age group, 218 (71.9%) of respondents were science students engaged in B.Sc and M.Sc degree programmes, 63 (19.8%) of them were computer science students studying in B.Sc (CS) and BCA programmes in various colleges.

Table 1. Demographic information of the respondents

Variable	Category	Count	Percentage
Gender	Male	211	66.6
	Female	106	33.4
Degree Programme	B.Sc	191	60.2
	M.sc	37	11.7
	B.Sc (CS)	55	17.3
	B.Com	10	3.2
	BCA	8	2.5
	MA	6	1.9
	Others	10	3.2
Family Income (yearly)	Below 1 Lakh	213	67.2
	1 lakh - 2 lakh	61	19.2
	2 lakh - 3 lakh	11	3.5
	3 lakh - 4 lakh	13	4.1
	Above 4 lakh	19	6
Age group	17 - 19	178	56.2
	20 - 22	125	39.4
	geq 23	14	4.4

4.2 Analysis of descriptive statistics

The descriptive statistics of the data show that the mean ratings of all the components fall in the interval (3, 3.6) (see table 2). In particular, section 3 of the component “components of teaching-learning process” scores the highest mean of 3.501 with the least S.D (0.982) and section 6 of the component “Preference for Online over Classroom learning” scores the lowest mean of 3.004 with the highest S.D of 1.28. Figure 1 displays the component-wise distribution of students against their ratings.



Table 2. Descriptive statistics and Cronbach’s α of the data

Sections	Components of the Questionnaire	Mean	S.D.	Number of questions	Cronbach’s α value
Sec2b	Device and Network	3.377	1.044	3	0.83
Sec3	Components of teaching-learning process	3.501	0.982	10	0.94
Sec4	Development in learning attitudes	3.484	1.093	9	0.94
Sec5	Accessibility, Happiness and Enjoyment	3.407	1.084	8	0.94
Sec6	Preference for Online over Classroom learning	3.004	1.28	3	0.84

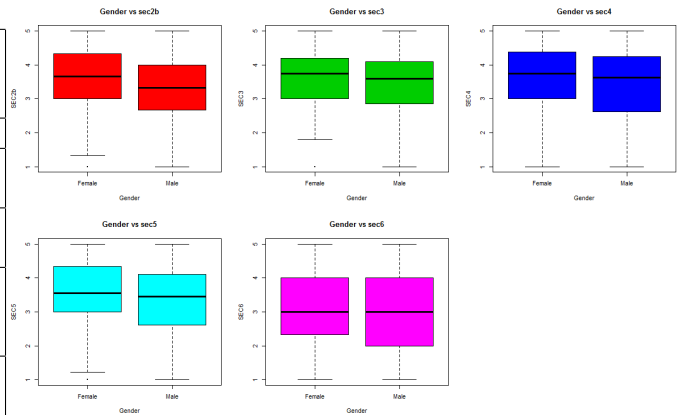


Figure 2. Gender wise distribution of respondents against various components

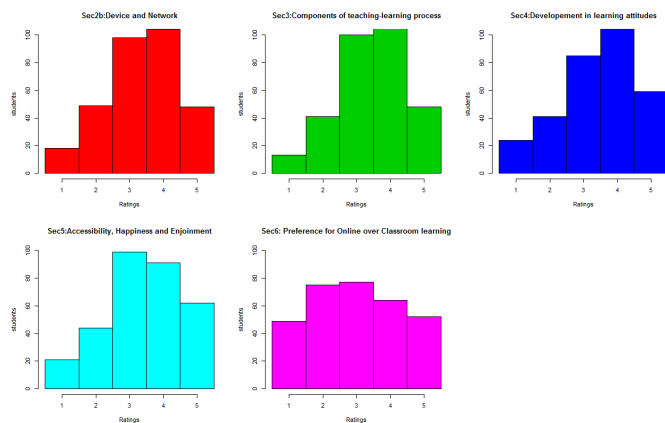


Figure 1. Component wise distribution of respondents

4.3 Response for the research question Q1

To find the answer for the first research question Q1, a paired t-test was conducted on the responses recorded by the students on the two questions of Sec2a. Only 10.8% of students rated their previous experience in the online learning process with ‘1’, around 77.1% of students scored ‘3 to 5’ for their experience, which implies that the majority of the students had a significant experience in the online learning process in the pre-pandemic period which was compared with their ratings for their experience during the pandemic period. Results show that the ratings on students’ experience in the online learning process are significantly decreased ($p=0.0072$) during the pandemic period, that is, the respondents were much happier with their pre-pandemic online learning process compare to that of during pandemic.

4.4 Response for research question Q2

In the search for the answer to the second research question Q2, various statistical tests and analyses were performed on the data. Figure 2 exhibits the gender-wise distribution of the collected data against various components of the questionnaire. It can be clearly seen that averages of ‘male’ and

‘female’ are almost the same in all the components except in sec2b, that is “Device and Network”. Table 3 represents the results obtained from the t-test conducted by considering ‘Gender’ as the independent variable and the scores obtained in various components as the dependent variable. Explicitly the results confirm that there is no significant difference between male and female concerning various components except sec2b ($p=0.02515 < 0.05$). that is, the device and network used by female students were significantly better than that of male students.

Table 3. Results of t-test for Gender against components

Components	Gender	Mean	t value	p value
Sec2b	Male	3.2859	2.2545	0.02515*
	Female	3.5697		
Sec3	Male	3.4412	1.5797	0.1156
	Female	3.6207		
Sec4	Male	3.4425	0.9411	0.3477
	Female	3.5672		
Sec5	Male	3.357	1.16	0.2473
	Female	3.5062		
Sec6	Male	3.1446	1.4159	0.1582
	Female	2.9336		

Further one way ANOVA test was conducted by considering all the demographic characteristics as independent variable and scores obtained in various components as the dependent variable. The various criterion of Income, Age group and degree programme were analysed and the results are exhibited in Table 4

Results of ANOVA detailed in Table 4 explores that the two demographic characteristics ‘Age group’ and ‘Degree programme’ has no significant effect on students’ perception of the online learning process concerning any component of the questionnaire. It can be clearly noticed that ‘Family Income’ of the respondents had a significant effect on sec2b ($p=0.00512 < 0.05$) and sec6 ($p=0.0315 < 0.05$). Tukey’s HSD



Table 4. ANOVA results of demographic variables against components of the questionnaire

Demographic Variable	Components	sum.sq	mean.sq	F value	p value
Family Income	Sec2b	15.9	3.98	3.779	0.00512*
	Sec3	3.57	0.8936	0.927	0.449
	Sec4	3.7	0.9327	0.778	0.54
	Sec5	5.8	1.462	1.247	0.291
	Sec6	17.2	4.308	2.687	0.0315*
Age group	Sec2b	0.6	0.275	0.252	0.777
	Sec3	2.89	1.4465	1.506	0.223
	Sec4	1.8	0.896	0.748	0.474
	Sec5	3.8	1.912	1.633	0.197
Degree Programme	Sec6	1.1	0.5641	0.343	0.71
	Sec2b	3.4	0.5639	0.512	0.799
	Sec3	2.99	0.4991	0.513	0.798
	Sec4	13.8	2.301	1.96	0.071
	Sec5	6.4	1.064	0.903	0.493
	Sec6	19.4	3.234	2.013	0.0636

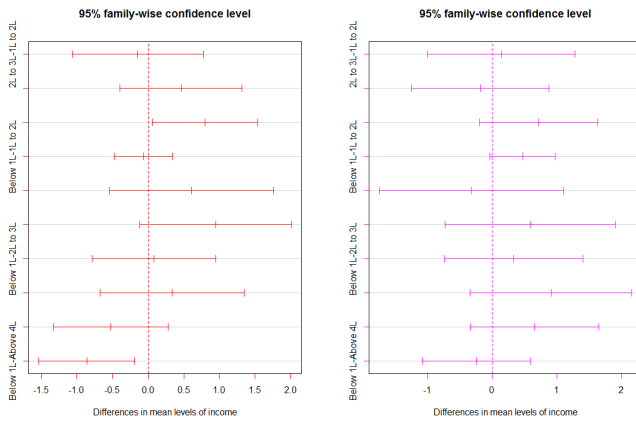


Figure 3. Tukey’s HSD graph income against sec2b and income against sec6

test was conducted on ‘Family Income’ to investigate further by considering sec2b and sec6 as dependent variables. Class of “Above 4L” significantly differ from two classes “less than 1L” ($p=0.0045$) and “1L to 2L” ($p=0.0274$) concerning the component ‘sec2b’, which clearly shows that ‘Device and Network’ of financially weaker students is significantly inferior than that of financially sound students (see the first image figure). Also, no evidence of pair-wise significant difference occurs in the Tukey HSD test with respect to sec6 (see the second image of figure 4) but the respondents had a divergent and heterogeneous idea on their preference of online over traditional classroom learning that is the reason for $p=0.0315 < 0.05$)

4.5 k-means clustering and Elbow method

To answer the research question Q3, the survey data was further subjected to k-means clustering, which is an unsupervised machine learning procedure that is proficiently engaged

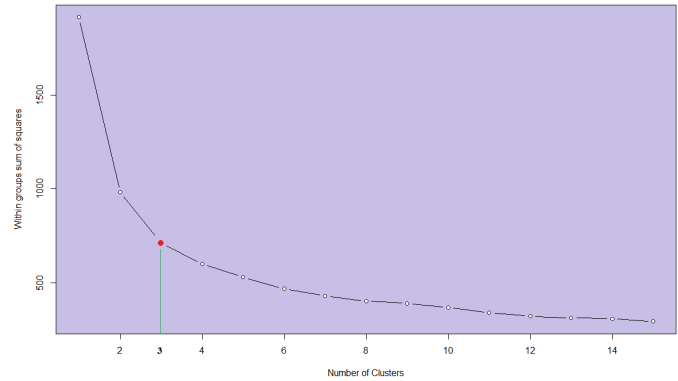


Figure 4. Estimation of the number of clusters using Elbow method

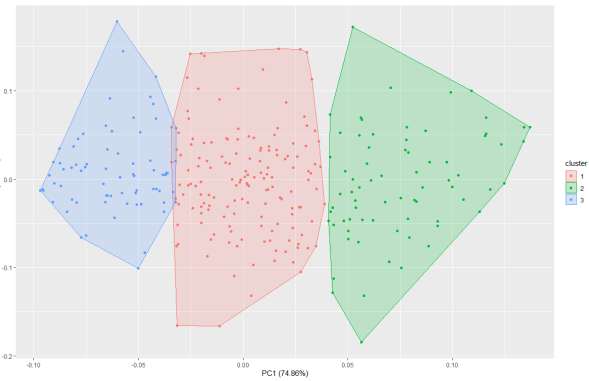


Figure 5. Survey data clustered using k-means algorithm

for partitioning the dataset under consideration into k groups called clusters. It is a procedure intended to explore the obscured patterns from the data to anticipate possible activities, expected trends, and group (cluster) the data based on similarities. The Elbow method is a diagrammatic method used to identify the optimal number of clusters to be derived out of the data. The idea is to determine a number ‘k’, the number of clusters, where the sum of square errors does not significantly decrease by increasing the k value. Using the elbow method the suitable k identified for our survey data is $k=3$ (see figure 4). By considering $k=3$, the data were subjected to the k-means algorithm. The figure 5 shows the clustering of the respondents into 3 groups. k-means clustering of results concerning each component of the questionnaire exhibited in Table 5 and the diagrammatical representation of the three clusters with respect to each component was displayed in figure 6.

The diagram in figure 6 minutely explains the position and level of each group of students belonging to the corresponding clusters with respect to each component and also the degree of difference between them. To confirm it further, the Chi-square test and One way ANOVA test were conducted to establish the differences between three clusters with respect to



Table 5. Data clusters against the components of the questionnaire

Attribute	Cluster Centroids			
	Full Data	Cluster A	Cluster B	Cluster C
sec2b	3.3775	3.3095	2.4594	4.2584
sec3	3.5013	3.4876	2.3081	4.5168
sec4	3.4842	3.5543	2.0152	4.5842
sec5	3.4069	3.3903	2.039	4.573
sec6	3.0042	2.8766	1.536	4.4456
No.of instances	317 (100%)	154 (48.58)	74 (23.34)	89(28.07)

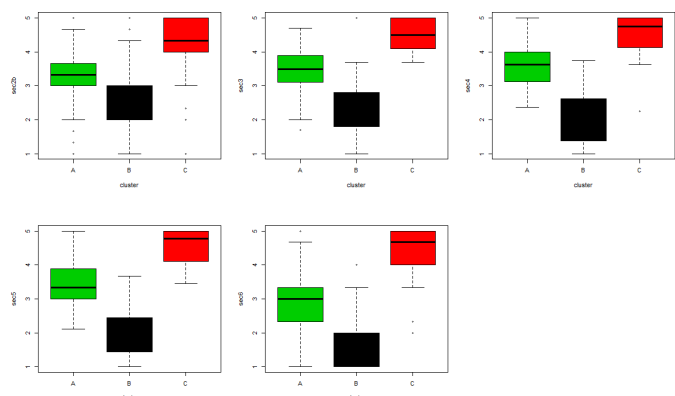


Figure 6. Clusters against various components

demographic variables and components of the survey. Initially ANOVA tests were conducted by considering clusters as the independent variable and each component as a dependent variable. Results detailed in Table 6 confirms that there is a significant difference among the clusters concerning every component as shown in figure 6.

Table 6. Results of ANOVA tests for clusters against components

	Components	sum.sq	mean.sq	F value	p value
Clusters	Sec2b	132.2	66.07	97.7	0.000
	Sec3	197.2	98.59	288.5	0.000
	Sec4	268.1	134.08	384.2	0.000
	Sec5	259.5	129.76	363.8	0.000
	Sec6	346.9	173.47	319.3	0.000

Further to compare clusters with demographic characteristics chi-square test was conducted as both of them are categorical variable. All the results of the tests are details in Table 7, which clearly declare that none of the demographic variables of a student has any influence on his position of being in any cluster.

5. Discussion and Conclusion

The purpose of the study is to understand and analyze the students' perception of the online learning process what they

Table 7. Results of Chi-square test for demographic variables against clusters

	Clusters	A	B	C	Chi square value	p value
Gender	Male	103	56	52	5.415	0.0667
	Female	51	18	37		
Family Income	1L-2L	34	17	10	11.96	0.153
	2L-3L	4	4	3		
	3L-4L	4	5	4		
	Above 4L	10	1	8		
	Below 1L	102	47	64		
Degree Programme	B Com	1	6	3	15.869	0.1973
	B.Sc	97	43	51		
	B.Sc(CS)	26	10	19		
	BCA	3	3	2		
	M.Sc	18	10	9		
	MA	5	0	1		
	OTHER	4				
Age group	17 - 19	80	47	51	4.6389	0.3264
	20 -22	68	25	32		
	above 23	6	2	6		

have undergone during the lockdown of Covid 19. Earlier students had some experience in learning from the internet such as youtube and other e-content shared through WhatsApp or other social media platforms but involving in a full-fledged learning process in which everything only through online is completely new to the students. An online survey on six components of the learning process was conducted in which 317 valid respondents who study in various colleges of Chennai city participated.

The data were analyzed in search of an answer for three research questions established in the earlier sections. Our findings are

1. Students were more satisfied with their online experience of learning before Covid 19 lockdown compares to that during the pandemic period.

2. Two demographic characteristics such as 'Gender' and 'Family Income' had a significant effect on a few components of the online learning process. The study on survey data predicted that female students are significantly satisfied with their 'device and Network' facilities utilized in online learning than that of male students. The students belonging to lower 'family Income' such as (Below 1L) and (1L – 2L) had a significantly lower satisfaction on the performance of 'device and network' than (Above 4L) category students. It may be due to the quality of the gadgets they used or/and the unaffordability of quality broadband network during the pandemic period. Also, students have a lot of differences among themselves in the 'Preference for online over classroom learning', but the average score (3.004) for this component is significantly less than that of other components with the highest standard deviation (1.28). none of the demographic characteristics had an effect on other components [sec3,sec4,sec5].

3. Students were categorized into three groups (A, B and C) using k-means clustering algorithm with (154,74 and 89)



instances respectively. There is no evidence to prove that any particular demographic characteristic has an effect on any student to be in any particular cluster. There are significant differences among students of all three clusters with respect to each and every component surveyed on the online learning process. Students of cluster B, 23.34% of the whole, scored between 1.5 to 2.5 on all the components of the survey and also the students of cluster A, 48.58% of the whole, scored between 2.8 to 3.6 on all the components. Only 28.07% of the students belonging to cluster C have scored between 4.2 to 4.6.

The main limitation of this research work is the sample selected is only from the few colleges of Chennai, Tamilnadu, which may not be the perfect representative for other districts of Tamilnadu or India. However, Chennai is the capital of Tamilnadu and the students of all over the state study in the educational institutions of Chennai and hence the reasonable variability can be expected from the sample of 317 students.

In fact, the online learning process which helped millions of students to continue their academic journey during the Covid 19 pandemic period was a great reward of technology to mankind. It brought top-class educational institutions to the homes of every individual student. Though some shortcomings were found in this process, they are absolutely manageable and solvable.

References

- [1] WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. [general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020](https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020).
- [2] Transformingindia.mygov.in. 2021. Due to lockdown with reference to the COVID 19 people have faced so many issues ;<https://transformingindia.mygov.in/due-to-lockdown-with-reference-to-the-covid-19-people-have-faced-so-many-issues/>
- [3] Williams, M. L., Paprock, K., & Covington, B. (1998). *Distance Learning: The Essential Guide*. SAGE Publications, Inc.
- [4] Sabir, I. R., Akhtar, N., Bahadur, W., Sajjad, M. S., & Abbas. Impact of distance education on student performance: A case of Allama Iqbal Open University. *Middle-East Journal of Scientific Research*, 2014, 21(3), 472-476.
- [5] Lehmann, K.; Chamberlin, L. *Making the Move to E-learning: Putting Your Course Online*; R&L Education: Lanham, MD, USA, 2009.
- [6] Basilaia, G. and Kvavadze, D.. Transition to Online Education in Schools during a SARS-CoV-2 Coronavirus (COVID-19) Pandemic in Georgia. *Pedagogical Research*,2020,5(4).
- [7] Ruthotto, I., Kreth, Q., Stevens, J., Trively, C. and Melkers, J.Lurking and participation in the virtual classroom: The effects of gender, race, and age among graduate students in computer science. *Computers & Education*, 2020, 151, p.103854.
- [8] Topal, A. D. Examination of university students' level of satisfaction and readiness for e-courses and the relationship between them. *European Journal of Contemporary Education*,2016, 15(1), 7–23.
- [9] Horton W. *Evaluating E-learning*. Alexandria, VA: American Society for Training and Development,2001.
- [10] Lehmann, K.; Chamberlin, L. *Making the Move to E-learning: Putting Your Course Online*; R&L Education: Lanham, MD, USA, 2009.
- [11] Kamali, A.; Kianmehr, L. The Paradox of Online Education: Images, Perceptions, and Interests. *US China Educ. Rev.* 2015, 15, 591–601.
- [12] Almaiah MA, Al-Khasawneh A, Althunibat A. Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Educ Inf Technol*, 2020, 1–20.
- [13] Biasutti, M. The student experience of a collaborative e-learning university module. *Comput. Educ.* 2011, 57, 1865–1875.
- [14] Roca, J.C.; Chiu, C.M.; Marthnez, F.J. Understanding e-learning continuance intention: An extension of the Technology Acceptance Model. *Int. J. Hum. Comput. Stud.* 2013, 64, 683–696.
- [15] Hrastinski, S. A Theory of Online Learning as Online Participation. *Comput. Educ.* 2009, 52, 78–82.
- [16] Richardson, J. C., Maeda, Y., Lv, J., & Caskurlu, S. Social presence in relation to students' satisfaction and learning in the online environment: A meta-analysis. *Computers in Human Behavior*, 2017, 71, 402–417.
- [17] Hutt, M. Top 10 disadvantages of distance learning 2017, <https://www.eztalks.com/elearning/top-10-disadvantages-of-distance-learning.html>.
- [18] Gupta, V.; Jain, N. Harnessing information and communication technologies for effective knowledge creation: Shaping the future of education. *J. Enterp. Inf. Manag.* 2017, 30, 831–855.
- [19] Cortina, J., What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, 1993, 78(1), pp.98-104
- [20] Kuyini, A., Yeboah, K., Das, A., Alhassan, A. and Mangope, B.. Ghanaian teachers: competencies perceived as important for inclusive education. *International Journal of Inclusive Education*,2016, 20(10), pp.1009-1023.

ISSN(P):2319 – 3786

Malaya Journal of Matematik

ISSN(O):2321 – 5666

