Original Article

THE STATISTICAL COMPARISON BETWEEN ONLINE AND OFFLINE EDUCATION

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DOI: 10.47750/pnr.2022.13.S06.250

Abstract

Coronavirus outbreak media pandemic impacted most of the sectors globally. This includes the academic world that consists of millions of enrolled learners and active teachers who previously had regular classes in their institutions, and due to the pandemic, got stuck at home. To continue the education process, the online class was introduced in most of the countries, including India. In this mode, both teaching and learning happen through electronic devices which are relatively new to the entire teaching-learning community. The purpose of research is to study the features of the subjective attitude of students to distance learning. This study will provide a comprehensive explanation of the level of effectiveness of online learning with statistical analysis on categorical data analysis through the questionnaire, descriptive statistics, and Chi-Square test with a research sample of 114 students. The study aims to investigate the effectiveness of online and offline education in higher education. The study was carried out among students of B.Sc. and M.Sc. students from different institutions among which major responses were from the youth studying in Bachelor's program.

Keywords: Statistics, Chi-square test.

INTRODUCTION

With the emergence of new information and communication technologies (ICTs), the style ofimparting education has undergone a lot of changes over the years. It is true that onlineeducation brings a lot of flexibility, but there are still concerns about its efficacy compared tooffline. Many researches havebeenconducted todeterminewhich one is better,but theresults obtained are mixed and inconclusive. India is a country ofdiversities, where financialcondition of people, accessibility to education, network infrastructure and the related factorshassomuchvariationamongthepopulation.Weseethatthereisatrendforonlineeducationas the data rates have been reduced drastically. This is becoming a new normal on account ofCovid-19[1, 2, 3, 4, 7, 8, 9, 10, 11] pandemic. There are numerous opportunities and challenges associated withmodern online education and traditional offline education. In this paper, we will discuss andcompare the two modes of education, i.e. online and offline and how well they cancomplementeachother[5, 6, 13].

In the current education sector, there are many major changes. One of them is the full use ofcloud- based video conferencing applications or sites or other online learning sites in theteaching and learning process to reduce physical contact between lecturers and students. Thevideo conference application is an attempt to optimize the distance learning system[12].Maximizing the benefits of using video conferencing applications will save costs andtime. Online learning is considered to be the only medium for delivering material during thecurrent pandemic emergency. Online learning is learning that uses an internet network withaccessibility, connectivity, flexibility and the ability to generate various types of learninginteractions[14].Online learninghasnotonlyjustbeenimplementedafterthepandemic,butonlinelearning has become aworld demand since thelast few years.

Theobjectiveofthestudyistoassesstheeffectivenessofonlineandofflinelearningthroughhigher education. The sudden outbreak of Covid-19 in various part of the world in 2020 hasseverely affected the educational institutions in various countries. Students were affected inthewaytoacceptthehybridformoflearningandalsograsptheinteresttowards theclassesthat were conducted online. The study aims to investigate the effectiveness of online andoffline education in higher education. The study was carried out among B.Sc. and M.Sc. students. The findings indicated that the effectiveness of onlineeducationisdismal,

asstudentsfinditdifficulttoadjusttotheonlinemodeofeducationandtheofflinemodeof education remainsthemostpreferredmode of education.

METHODOLOGY

The method of data collection is of primary data. A questionnaire-basedonline survey (Google form) was used to evaluate the online learning effect of primaryschool, high school, PUC, undergraduate and postgraduate as primary data and secondarydata is collected from various articles, internet and websites. It is composed of 17 structuredquestions with simple alternative answers and one open question regarding the comments ofonlinelearning. Elementsof the questionnairearementioned below. Thelink ofquestionnaire was mailed (distributed) to certain number of students who were interested in the survey to do. The students can decide whether to participate in this surveyof theirownwill. Thenameand otherpersonalinformation of theparticipantswereprotected. All the questionnaire's (Table-1) design obligated the participants to answer all the questions to make sure that the returned electronic forms were all complete. The questionnaire is filledupby114 studentsof primaryschool, highschool,PUC, undergraduateandpost graduate.

From the total of 114 students: 1 from primary school ,17 from high school , 4 from PUC , 76from under graduate and 16 from post graduate. Where most of the response arefrom the population of under graduate students. The result was given by using thestatisticalmethodsknown as"DESCRIPTIVESTATISTICS"andby"CHI-SQUARETEST".

DESCRIPTIVESTATISTICS[15]: Descriptivestatisticssummarizesordescribesthecharacteristicsofadataset.

TypesofDescriptiveStatistics:Itconsistsoftwobasiccategoriesofmeasures:

i) Measuresofcentraltendency

ii) Measuresofvariability(orspread),alsoknownasmeasuresofdispersion.

MeasuresofCentralTendency: Measuresofcentraltendencydescribethecenterofadataset

orfocusonaverageormiddlevaluesofdatasets.Apersonanalysesthefrequencyofeachdata

pointindistributionanddescribesitusingmean,median,mode;whichmeasuresthemostcommon

patternsoftheanalyzeddataset.It givesapersontheaverageofadataset,itdoesnotdescribe

howthedataisdistributedwithin theset.

MeasuresofVariability: Measuresofvariabilitydescribethedispersionofdatawithintheset and

aidsinanalyzinghowdispersedthedistributionforasetofdata.

USES: Thesetwomeasuresusegraphs,tablesandgeneraldiscussionstohelppeople tounderstand

the meaningoftheanalyzeddata.

Descriptive statistics can be useful for two purposes:

i) To provide basic information aboutvariablesin adataset

ii) Tohighlight potentialrelationshipsbetween variables.

CHI-SQUARETEST[15]

Chi-square test can be used to test the hypothesis if the population consists of two or moreclasses where the data is categorical. Chi-square test is the most widelyusednon-parametrictest.Inthis study,ifit isseenfromtheexisting populationthat theproportions of each category are seen, the purpose of the hypothesis testing carried out here istopredict if thenumberof samplesis developed tobelarger, itis necessarytodo a test.

Therearetwotypes ofCHI-SQUAREtests.

i) A CHI-SQUARE GOODNESS OF FIT TESTdetermines if sample data matchesapopulation.

ii) A CHI-SQUARE TEST FOR INDEPENDENCEcompares two variables in a contingencytable to see if they are related. In a more general sense, it tests to see whether distributions ofcategoricalvariables differ from eachanother.

Chi-squaretestofindependence[15]

The Chi-square test of independence checks whether two variables are likely to be related ornot. We have counts for two categorical or nominal variables. We also have an idea that thetwovariables arenot related. Thetest gives usa wayto decide ifour ideaisplausibleornot.

Like all hypothesis tests, the chi-square test of independence evaluates a "null and alternativehypothesis". The hypotheses are two competing answers to the question: "Are variable-1 andvariable-2 related?"

- Null hypothesis (H0): Variable-1 and variable-2 are not related in the population OR the proportionsof variable-1arethesamefor differentvalues of variable-2.

- Alternative hypothesis (H1): Variable-1 andvariable-2 are related in the population OR theproportions of variable-1 arenotthesame fordifferent values ofvariable-2.

Uses of Chi-squaregoodness offittest

The Chi-square goodness of fit test checks whether your sample data is likely to be from aspecific theoretical distribution. We have a set of data values, and an idea about how the datavalues are distributed. The test gives us a way to decide if the data values have a "goodenough"fit to ouridea, or ifour ideais questionable.

FORMULATION: Theformulafor thechi-squarestatisticusedin thechisquaretest is:

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where

- χ 2 is thechi-squareteststatistic.

- Σis thesummation operator. (itmeans "takethesum of")

- Oiis theobserved frequency.

- Eiistheexpected frequency.

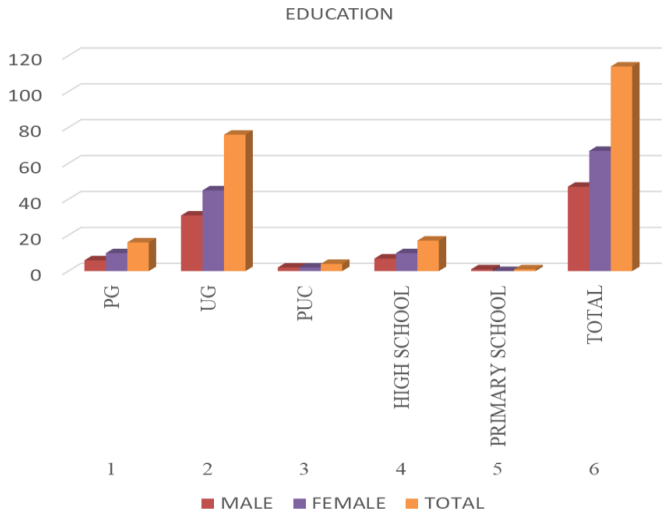
Table-1: Questionnaire

Sl.No.	Questions
1	Name
2	Education
3	Areyousatisfiedwithonlineteaching?
4	Doyouhaveproperinternet accessathome?
5	Difficultiesfacedinonlineteaching.
6	Whethertheonlineclasseswerevery wellorganized?
7	Doyou thinktheonlineteaching isimportantfor thegrowth inyourcareer?
8	Weretheinstructor's methods helpedinunderstandingthetopicbetter?
9	Wasthe teachingenvironmentattheonlineclasshelpedin betterlearning?
10	Whetherinnovativemethodsof teachingseen in online?
11	Wasthe teacherbeing approachableforhelp?
12	Whatisyouropinionon onlineclasses?
13	Astheofflinelearningresumes,howcomfortable areyouinreturningtothecollege?
14	Assuming appropriate safety measures in place, which type of learning would youprefer?
15	I believe that learning on the internet outside of class is more motivating than aregularcourse.
16	AsastudentIenjoyworking independently.
17	Ibelieveacompletecoursecan begiven through theinternet without difficulty.

DATACOLLECTION: Theanswersforthequestionnairefor each questionsaregivenbelow.

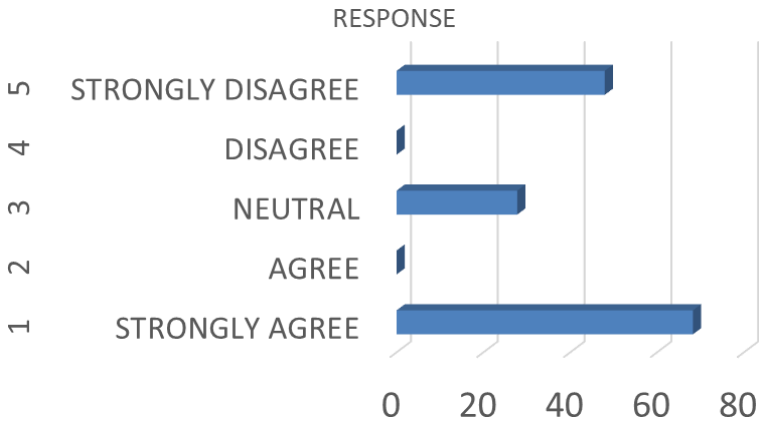
1. Education:-

©©	LEVELOF STUDY	MALE	FEMALE	TOTAL
1	PG	6	10	16
2	UG	31	45	76
3	PUC	2	2	4
4	HIGHSCHOOL	7	10	17
5	PRIMARYSCHOOL	1	0	1
6	TOTAL	47	67	114



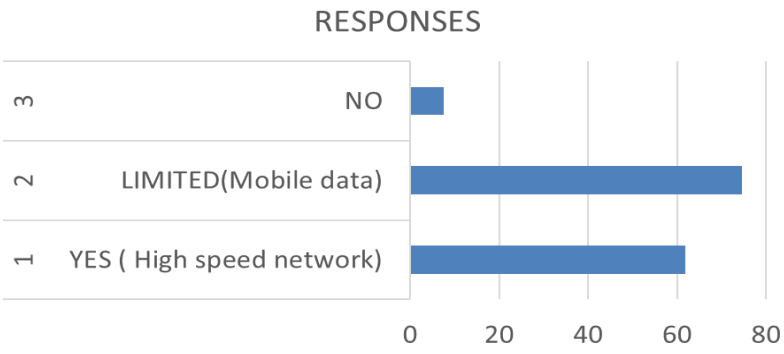
2. Areyousatisfiedwithonlineteaching?

Sl.No.	STRATEGY	RESPONSE
1	STRONGLYAGREE	68.25
2	AGREE	0
3	NEUTRAL	27.79
4	DISAGREE	0
5	STRONGLYDISAGREE	47.95



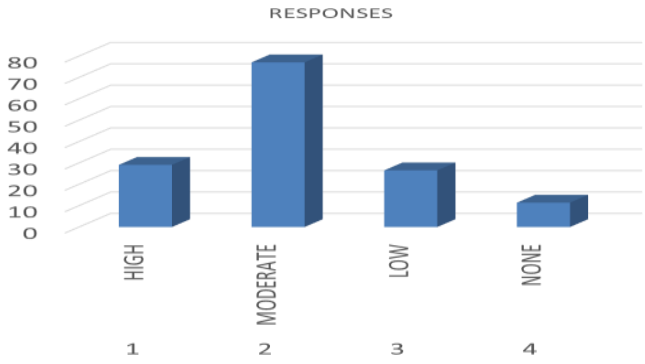
3. Doyou haveproperinternetaccess athome?

Sl.No.	STRATEGY	RESPONSES
1	YES(Highspeednetwork)	61.92
2	LIMITED(Mobiledata)	74.59
3	NO	7.63



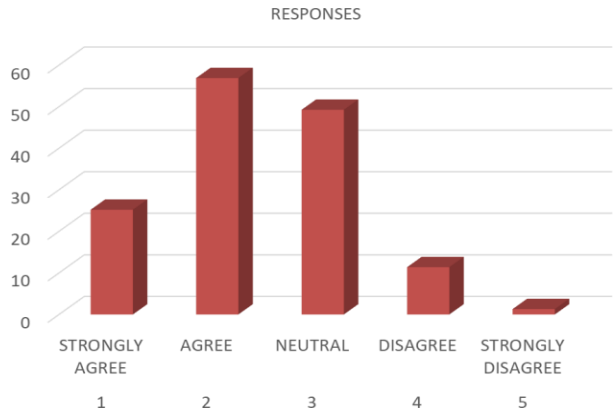
4. Difficultiesfacedinonlineteaching.

Sl.No.	STRATEGY	RESPONSES
1	HIGH	29.08
2	MODERATE	77.04
3	LOW	26.496
4	NONE	11.376



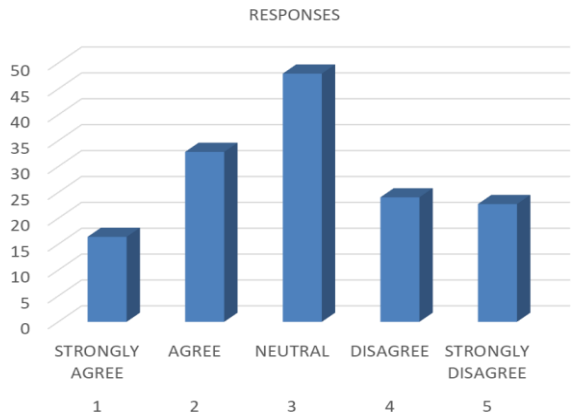
5. Whethertheonlineclasseswerevery well organized?

Sl.No.	STRATEGY	RESPONSES
1	STRONGLYAGREE	25.2
2	AGREE	56.88
3	NEUTRAL	49.248
4	DISAGREE	11.376
5	STRONGLYDISAGREE	1.296



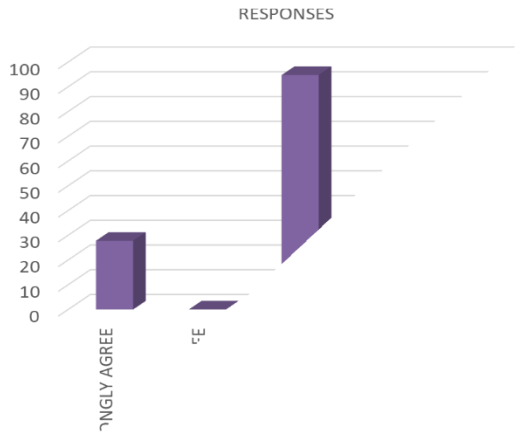
6. Doyouthinktheonlineteachingisimportantforthegrowthinyourcareer?

Sl.No.	STRATEGY	RESPONSES
1	STRONGLY AGREE	16.416
2	AGREE	32.832
3	NEUTRAL	47.952
4	DISAGREE	24.048
5	STRONGLY DISAGREE	22.752



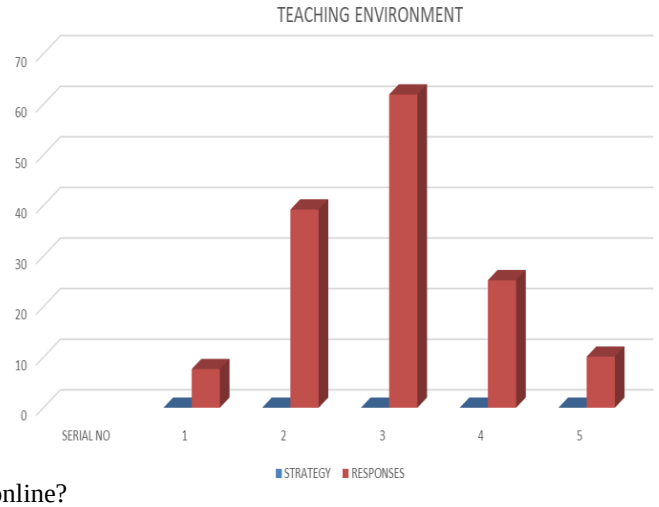
7. Weretheinstructor'smethodshelpedinunderstandingthetopicbetter?

Sl.No	STRATEGY	RESPONSES
1	STRONGLY AGREE	27.792
2	AGREE	0
3	NEUTRAL	94.752
4	DISAGREE	0
5	STRONGLY DISAGREE	21.456



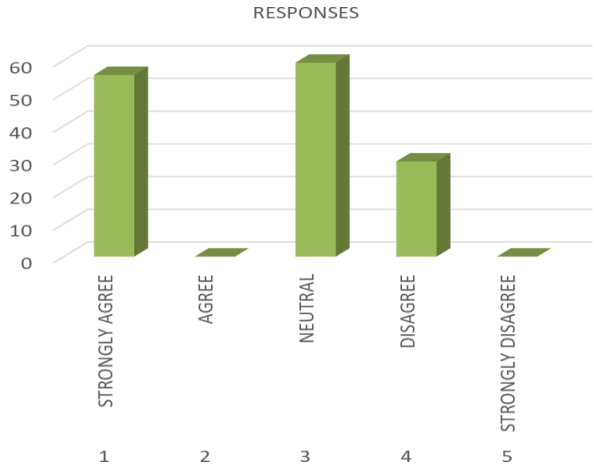
8. Wastheteachingenvironmentattheonlineclasshelpedinbetterlearning?

Sl.No.	STRATEGY	RESPONSES
1	STRONGLY AGREE	7.632
2	AGREE	39.168
3	NEUTRAL	61.92
4	DISAGREE	25.2
5	STRONGLY DISAGREE	10.08



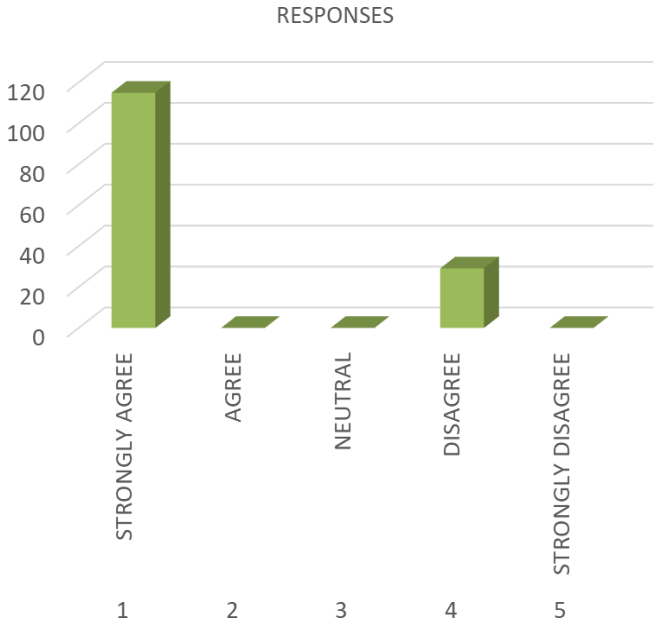
9. Whetherinnovativemethods ofteachingseeninonline?

Sl.No.	STRATEGY	RESPONSES
1	STRONGLY AGREE	58.176
2	AGREE	0
3	NEUTRAL	35.424
4	DISAGREE	0
5	STRONGLY DISAGREE	50.544



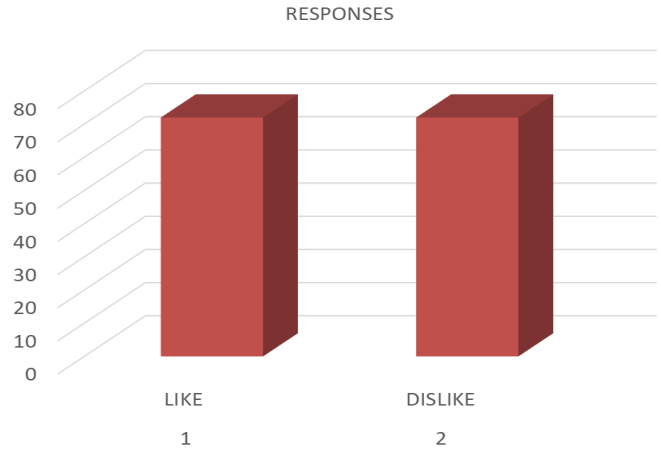
10. Was the teacher being approachable for help?

Sl.No.	STRATEGY	RESPONSES
1	STRONGLY AGREE	114.912
2	AGREE	0
3	NEUTRAL	0
4	DISAGREE	29.088
5	STRONGLY DISAGREE	0



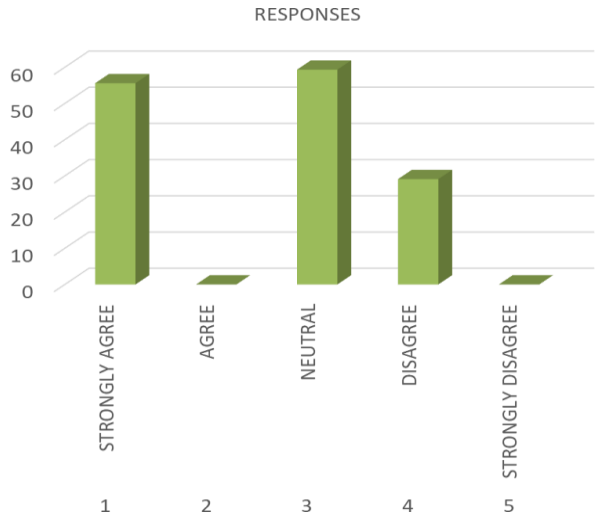
11. Whatisyouropinionononlineclasses?

Sl.No.	STRATEGY	RESPONSES
1	LIKE	72
2	DISLIKE	72



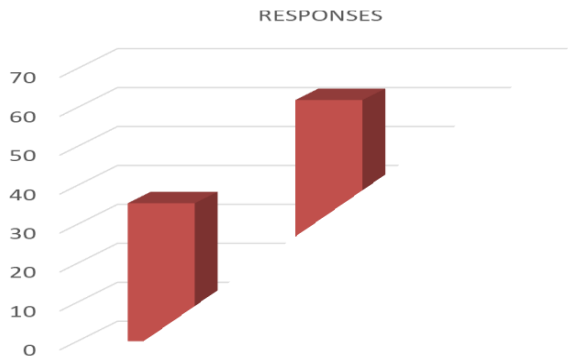
12. As the offline learning resumes, how comfortable are you in returning to thecollege?

Sl.No.	STRATEGY	RESPONSES
1	STRONGLY AGREE	55.584
2	AGREE	0
3	NEUTRAL	59.328
4	DISAGREE	29.088
5	STRONGLY DISAGREE	0



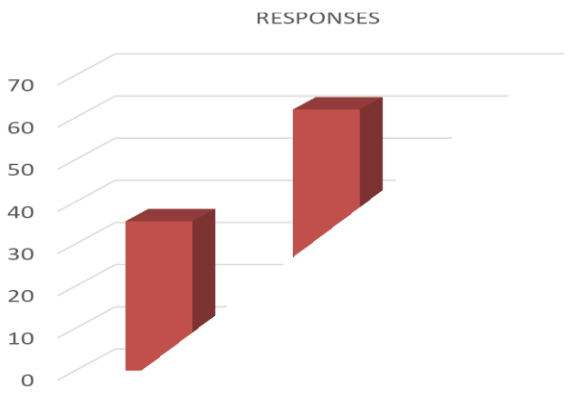
13. Assuming appropriate safety measures in place, which type of learningwouldyouprefer?

Sl.No.	STRATEGY	RESPONSES
1	ONLINECLASS	35.424
2	OFFLINECLASS	61.92
3	BOTH	46.8



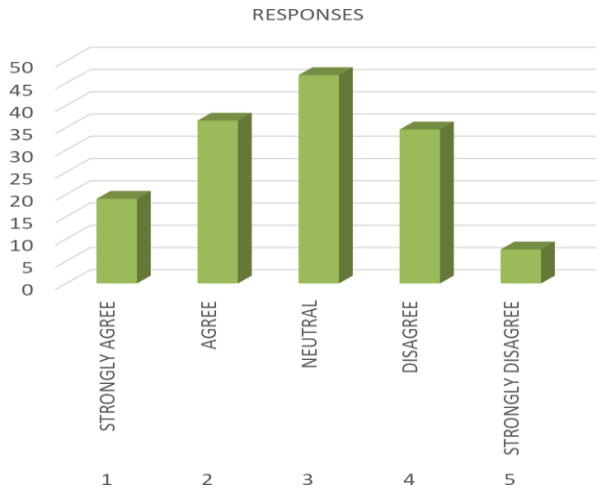
14. Assuming appropriate safety measures in place, which type of learningwouldyouprefer?

Sl.No.	STRATEGY	RESPONSES
1	ONLINECLASS	35.424
2	OFFLINECLASS	61.92
3	BOTH	46.8



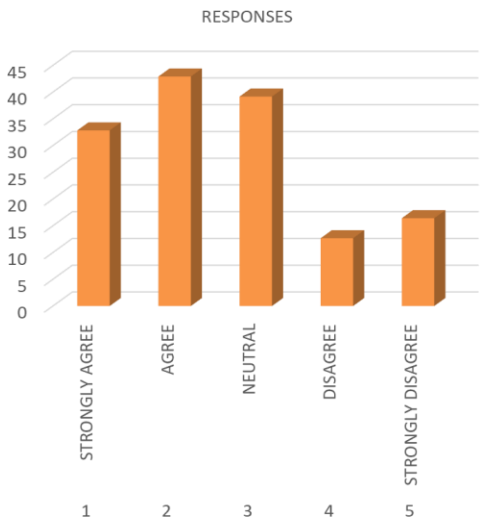
15. I believe that learning on the internet outside of class is more motivating than a regular course.

Sl.No.	STRATEGY	RESPONSES
1	STRONGLY AGREE	19.008
2	AGREE	36.576
3	NEUTRAL	46.8
4	DISAGREE	34.576
5	STRONGLY DISAGREE	7.632



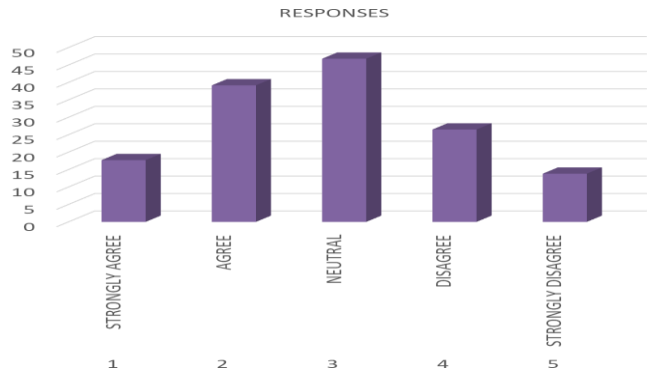
16. Asastudent,Ienjoyworkingindependently.

Sl.No.	STRATEGY	RESPONSES
1	STRONGLY AGREE	32.832
2	AGREE	42.912
3	NEUTRAL	39.162
4	DISAGREE	12.672
5	STRONGLY DISAGREE	16.416



17. Ibelieve a complete course can be given through the internet withoutdifficulty.

Sl.No	STRATEGY	RESPONSES
1	STRONGLYAGREE	17.712
2	AGREE	39.168
3	NEUTRAL	46.8
4	DISAGREE	26.496
5	STRONGLYDISAGREE	13.824



Sample of R-Codes based on questions…

1. data<-matrix(c(values),ncol=2,byrow=T)

colname(data)<-c("Male", "Female")

rowname(data)<-c("PG", "UG", "PUC", "High school", "Primaryschool")

data<-as.table(data)

chisq.test(data)

2. data <- matrix(c(values) , ncol = 2 , byrow = T)

colname(data)<-c("Strategy", "Responses")

rowname(data)<-c("Stronglyagree", "Agree","neutral","disagree"", , "Sronglydisagree")

data<-as.table(data)chisq.test(data)

CONCLUSION

This paper shows the effective mode of the education that the students prefer. The majortransformation during the COVID-19 pandemic was the shift of the entire education system fromtraditional to virtual mode. Although in this era of tech-savvy generation, information andcommunication technology in student's daily lives has not always resulted in enrichedlearning. Our findings indicate that there opinion (Table-2) on online classes is of 50% that is their likeand dislike is of equalmajority of the student's preferred face-to-face learning. Most of thestudents find it difficult to cope up with technology-aided learning and encounter glitcheswith the internet connectivity while using various online platforms. Students have a negativeattitudetowards E-learningand haveacceptedit onlypartially.

RESULTS using R-codes

Table2: Results of Chi-squaretest.

QUESTIONNUMBER	CHI-SQUAREVALUES	DEGREES OF FREEDOM	P-VALUES
01	1.6504	4	0.7997
02	123.78	4	$2.2e^{-16}$
03	52.668	2	$3.658e^{-12}$
04	67.471	3	$1.484e^{-14}$
05	79.154	4	$2.632e^{-16}$
06	20.68	4	0.0003665
07	210.54	4	$2.2e^{-16}$
08	69.997	4	$2.273e^{-14}$
09	105.4	4	$2.2e^{-16}$
10	343.88	4	$2.2e^{-16}$
11	0	1	1
12	114.87	4	$2.2e^{-16}$
13	7.3542	2	0.0253
14	33.257	4	$1.058e^{-06}$
15	25.565	4	$3.872e^{-05}$
16	27.223	4	$1.792e^{-05}$

REFERENCES

1. Noor R, Singh D, Agarwal A, Mansoori S, Ansari MI. Perception of dental studentstowards the online method of dental education during the COVID-19 pandemic. Journaloforal biology and craniofacial research.2022-Mar-1; Vol.12(2); pp: 22-37.
2. YinZ,JiangX,LinS,LiuJ.TheimpactofonlineeducationoncarbonemissionsinthecontextofthecOVID-19 pandemic–Taking Chinese universities as examples. AppliedEnergy.2022-May-15; Vol.3 (14): 118875.
3. Kunaviktikul W, Ang E, Baridwan NS, Bernal AB, Dones LB, Flores JL, Freedman-DoanR, Klunklin A, Lee WL, Lin CC, Luk TT. Nursing students' and faculty members'experiences of online education during COVID-19 across Southeast Asia: A Photovoicestudy.Nurseeducationtoday.2022-Apr-1; Vol.111:105307.
4. YasminM.OnlinechemicalengineeringeducationduringCOVID-19pandemic:LessonslearnedfromPakistan. Educationfor ChemicalEngineers. 2022Apr1;Vol.39, PP:19-30.
5. BelousovaA,MochalovaY,TushnovaY.AttitudetoDistanceLearningofSchoolchildrenand Students: Subjective Assessments of Advantages and Disadvantages. EducationSciences.2022-Jan; Vol.12(1):46.
6. MuthuprasadT,Aiswarya S,AdityaKS,Jha GK.Students'perception andpreferenceforonline education in India during COVID-19 pandemic. Social Sciences & HumanitiesOpen.2021-Jan1; Vol.3(1):100101.
7. Naik GL, Deshpande M, Shivananda DC, Ajey CP, Manjunath Patel GC. OnlineTeaching and Learning of Higher Education in India during COVID-19 EmergencyLockdown.Pedagogical Research. 2021; Vol.6(1).
8. Martín Ayala JL, Castaño Castaño S, Hernández Santana A, Martí González M, BritoBallester J. Impact of learning in the COVID-19 era on academic outcomes ofundergraduatepsychology students.Sustainability. 2021-Jan; Vol.13(16): 8735
9. Gautam DK, Gautam PK. Transition to online higher education during COVID-19pandemic: turmoil and way forward to developing country of South Asia-Nepal. JournalofResearch inInnovativeTeaching& Learning.2021-Jan-22.
10. Yonalia SF, Gunawan PH. The Analysis Of Online Learning Tools Based On StudentsSurveyDueTo Covid-19Pandemic. E ProceedingsofEngineering.2021-Jun-1; Vol.8(3).
11. Muflih S, Abuhammad S, Al-Azzam S, Alzoubi KH, Muflih M, Karasneh R. Onlinelearning for undergraduate health professional education during COVID-19: Jordanianmedicalstudents' attitudesand perceptions.Heliyon. 2021-Sep-1; Vol.7(9):e08031.
12. Selvaraj A, Radhin V, Nithin KA, Benson N, Mathew AJ. Effect of pandemic basedonlineeducation on teaching and learning system. International Journal of EducationalDevelopment.2021-Sep-1; Vol.85:102444.
13. Aderibigbe SA. Can online discussions facilitate deep learning forstudents in GeneralEducation?Helidon. 2021-Mar -1; Vol.7(3):e06414.
14. Chang JY, Wang LH, Lin TC, Cheng FC, Chiang CP. Comparison oflearningeffectiveness between physical classroom and online learning for dental education duringtheCOVID-19 pandemic.Journal of DentalSciences. 2021Oct 1; Vol.16(4):1281-9.
15. S C Gupta, V K Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand Publications, 11-Edition, 2010.