The Role Of Machine Learning Techniques In Exploration Of Impacts Of E-Learning During Covid-19 Pandemic: A Comparative Analysis Of Models

Baljit Saini[1*], Sanjay Bansal[2], Bhupinder Chaudhary[3], Kinjal Jani[4]

[1*]Department of Computer Engineering, K.D. Polytechnic, Patan-384265, Gujarat.
Email: sainibaljit@gmail.com
[2]Director, Rajasthan Vidyapeeth Technology College, Udaipur-313001, Rajasthan.
Email: sanjay_bansal40@yahoo.com
[3]Department of Hospital Management and Hospice Studies, Jamia Millia Islamia, New Delhi-110025
Email: bchaudhary@jmi.ac.in
[4]Department of Hospital Management, HNGU, Patan-384265, Gujarat.
Email: drkinjalhvyas@gmail.com

***Corresponding author**: Baljit Saini
[*]Department of Computer Engineering, K.D. Polytechnic, Patan-384265, Gujarat.
Email:sainibaljit@gmail.com

Abstract:
The coronavirus, which originated in Wuhan (China), has expanded to both developed and poor nations, with the developed nations like America, Italy, etc. currently suffering the most from its effects. Lockdown has had the greatest negative economic effects. This pandemic also affected the education system, so it is clear that education has been impacted by the COVID 19 outbreak. The occurrence prompted educators to consider different teaching strategies during the confinement. Thus, it opens the door for online learning, Learning has entered the digital realm in the current circumstances. where students and academic experts are virtually connected. E-learning is very easy to use and comprehend. This study will assist in determining the students' interest in online learning, as well as their preferred learning styles, platforms, and methods of material delivery both during and after the COVID-19 Pandemic. To discover more about how e-learning has helped during this pandemic, this study was conducted for technical education students as well as those who attend colleges and universities in Gujrat State. In this study, various machine learning models were evaluated to find out the best model or technique to analyse impact of e-learning during this pandemic and the student's interest towards the e-learning. The proposed model also compared with the previously implemented models and achieved the higher accuracy i.e. 88.56%, 91.45% for training and testing respectively.

Keywords: E-learning, Decision Tree, Logistic Regression, Naïve Bayes, k-Nearest neighbour.

INTRODUCTION

The COVID-19 pandemic has provided us with an opportunity to pave the way for introducing digital learning [1]. Research highlights certain dearth such as the weakness of online teaching infrastructure, the limited exposure of teachers to online teaching, the information gap, non-conducive environment for learning at home, equity and academic excellence in terms of higher education [2]. As Gujarat, a state on the western coast of India, geared up to address coronavirus (COVID-19) related emergencies, its authorities knew that 25-30% of students had limited or no access to remote learning devices. Reaching the unreachable was a challenge. With material in place, the next step focused on ensuring it reached every student. Measurement facilitated customized needs-based delivery. Gujarat regularly measures the learning level of students. The state has instituted an incredible system of Periodic Assessment Tests (PAT), which are formative weekly tests on each subject [3]. Gujarat undertook an exhaustive device-mapping exercise to measure the type/medium of access to remote education, be it television, smartphones, regular cellphones, tablet, radio, or none of these. For instance, for the 50% of students identified as having access to television, the state collaborated with a national broadcasting channel to stream six hours of daily learning programs, 30 minutes for each grade; and runs a 24/7 broadcast on a dedicated channel [4].
The COVID-19 pandemic has also had a severe impact on higher education as universities closed their premises and countries shut their borders in response to lockdown measures. Although higher education institutions were quick to replace face-to-face lectures with online learning, these closures affected learning and examinations as well as the safety and legal status of international students in their host country. Perhaps most importantly, the crisis raises questions about the value offered by a university education which includes networking and social opportunities as well as educational content. To remain relevant, universities will need to reinvent their learning environments so that digitalisation expands and complements student-teacher and other relationships [5].

LITERATURE REVIEW

E-learning tools have played a crucial role during this pandemic, helping schools and universities facilitate student learning during the closure of universities and schools [6]. While adapting to the new changes, staff and student readiness needs to be gauged and supported accordingly. The learners with a fixed mindset find it difficult to adapt and adjust, whereas the learners with a growth mindset quickly adapt to a new learning environment. There is no one-size-fits-all pedagogy for online learning. There are a variety of subjects with varying needs. Different subjects and age groups require different approaches to online learning [7].

One of the technologies used during COVID-19 is e-learning, a media integration for teaching that uses a consolidated platform to organize communication processes during instructional activities. Innovative networks of technology, such as Edmodo, social media, forum, Coursera, or special higher education platforms, apply computer-managed e-learning to immersive online learning. By the use of the e-learning system [8][9]. In the plethora studies [10][11], the use of the e-learning system as a research object was discussed. Some recent studies have also been reported during COVID-19 [12] on e-learning system applications in education. However, research on the adoption of the e-learning system is still limited in developed countries and, in particular, on topic matters. This thesis was therefore conducted to understand variables predicting the eventual use of the e-learning method through path analysis by university students. Universities and school doors were closed to restrict the dissemination of COVID-19[13].

The higher education system is currently in a constant transformation phase, with universities having to keep pace with the demands and expectations of students. Accordingly, information technology and e-learning platforms are key factors in the implementation of the activities of universities, which are increasingly investing in online systems and devices [14].

Authors of the study [15], wrote a research paper “COVID-19 Era: Students’ Role to Look at Problems in Education System during Lockdown Issues in Maharashtra, Gujrat, India”. According to the findings of a study based on student feedback, Lockdown has a significant impact on education. Students are unable to concentrate on their schoolwork as a result of Lockdown difficulties, while some students claim that there is a good benefit. Exams should be conducted entirely online, and college teachers should deliver lectures entirely online during the lockdown. These difficulties have increased the cost of schooling to some extent, and they have impacted many sectors, not only the education sector. Some pupils believe it is also an opportunity to experiment with lockdown concerns.

Authors of the study [16], made a study on “E-Learning during Lockdown of Covid-19 Pandemic: A Global Perspective” E-learning appears to be the next big thing, according to the survey. It has been spreading widely. For everyone, the online learning approach is the ideal option. Many people opt to learn at a convenient time based on their availability and comfort. This allows the student to have access to the most up-to-date content whenever they desire. It provides pupils with a wide range of benefits. The study's findings show the impact of E-learning, as well as students' enthusiasm in using E-learning resources and their performance. This survey found that E-learning has grown in popularity among students all throughout the world, notably during the COVID-19 pandemic lockdown period.

A study [17] on “Impact of Pandemic COVID-19 on Education in Gujrat, India”, The global impact of pandemic COVID-19 can be seen in every industry. This has a negative impact on Gujrat, India's and the world's education sectors. It has imposed a global lockdown, which has had a negative impact on the lives of pupils. Around 32 million students were unable to transfer schools or universities, and all educational activities in Gujrat, India were halted.

Authors conducted an online survey. This study [18] investigated parents' experiences and problems during school closure. Parents agreed with the school closure policy and were generally content with the degree of support offered by school districts; however certain areas of difficulties were mentioned. Parents stated that balancing obligations, learner motivation, accessibility, and learning results were difficult for them. The study's findings have crucial ramifications and suggestions for educators and policymakers.

RESEARCH OBJECTIVE

As the pandemic of COVID-19, affected the whole world in every field of working. The academic domain also suffered from this pandemic but fortunately it open a new way of teaching and learning i.e. online learning. However, e-learning has been a way of learning for past years, but after COVID-19 it became more popular in fact in school, and colleges. This study is preamble to analyse:

1. The student’s interest in overall online study, what he likes? What he dislikes? Which way of content delivery is more efficient to him? Etc.
2. The second objective of this study is to identify the best predictive model for the said prediction.

METHODOLOGY

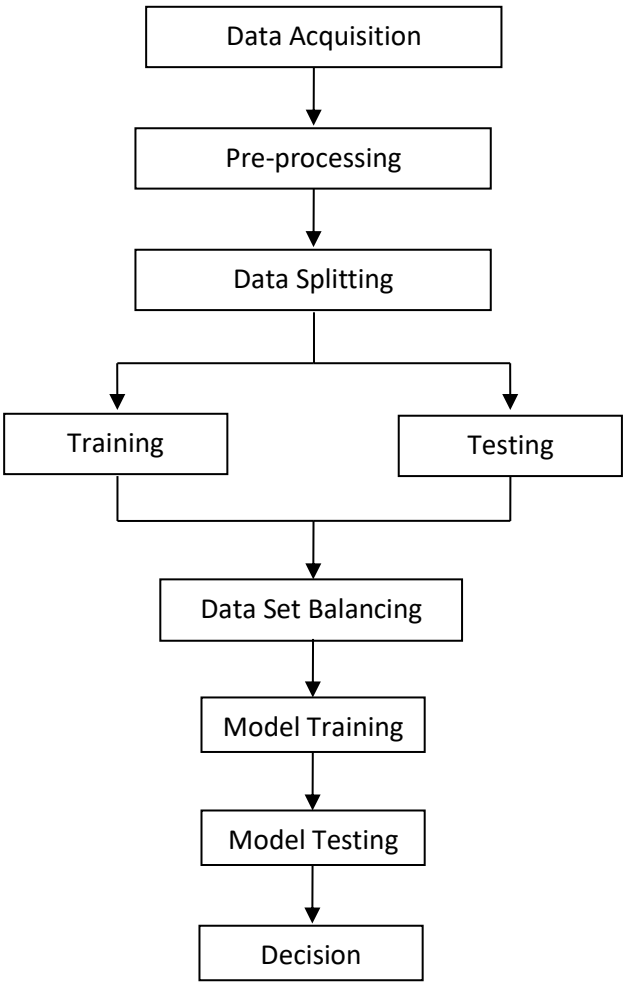


Fig. 1: Proposed Model workflow

Data Acquision: The data used in this study, have been collected through the online survey from the students of technical education. This survey has been conducted in all regions of Gujrat. The dataset contains more than 10000 records having the true information, and 23 columns. The columns are defined as some questions from student about his/her experience during the online learning and offline learning. The asked questions play very important role to identify the pros and cons of online learning during COVID-19 pandemic and it.

Dataset Description:

Table 1: Dataset Attribute and their Data types

Attributes	Data type
Timestamp	Date/Time
Email Address	String
Name	String
City	String
Region	Nominal
Did you attend online classes as part of your curriculum?	Nominal
Select the type of your Technical Education.	Nominal
From which device did you attend the online classes?	Nominal
How you felt after taking online lecture?	Nominal
Which Tool/Platform did you use for online classes?	Nominal
Was the use of online learning platform convenient?	Nominal

Level of interaction during the class?	Nominal
Lectures given in the online classes were helpful ?	Nominal
Attendance in online classes?	Nominal
Contents provided in online class were helpful?	Nominal
Contents were confusing?	Nominal
Contents were creative?	Nominal
Doubt clarification was helpful?	Nominal
In which mode you took Tests?	Nominal
Scores before online learning? (if Score is Less than 40%, Select Low, Greater than 40% and Less than 70%, Select Average and Greater than 70%, Select Good)	Nominal
Scores After online learning?	Nominal
Overall experience of online learning.	Nominal
score	Nominal

Pre-processing: In this phase of study, the data have been pre-processed in terms of data cleaning, Data cleaning includes the elimination of missing valued records, duplicate valued records, histogram calculations for each attribute with the value of alpha 0.7, and finding and dropping the unique valued records.

Data Splitting: The whole dataset has been split into two categories i.e. Training Set and Testing Set. The training dataset contains the prediction attribute named as 'Target' attribute but in the testing set, it has been removed. The train data shape was (701, 19) and test data shape was (227, 19).

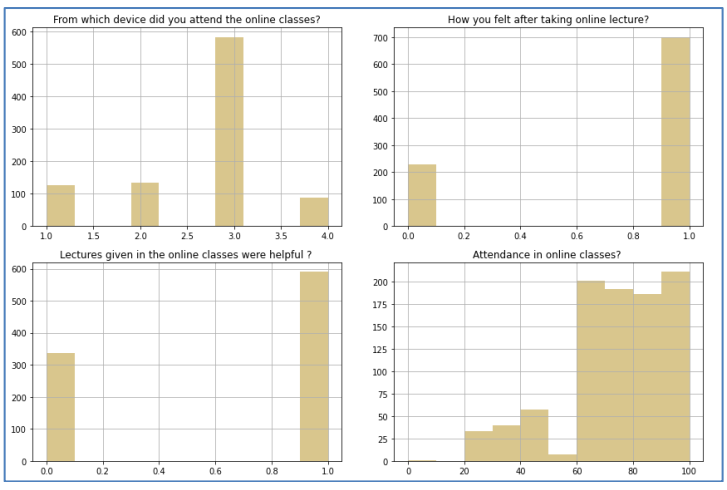
Data Balancing: To remove the abnormal distribution of data, the dataset has been balanced using some sampling mechanisms. The under sampling and over sampling is applied according to the requirement. For under sampling the Near miss and Random Under Sampler algorithms were used and for Over sampling Random Over Samplere and SMOTE algorithms were used.

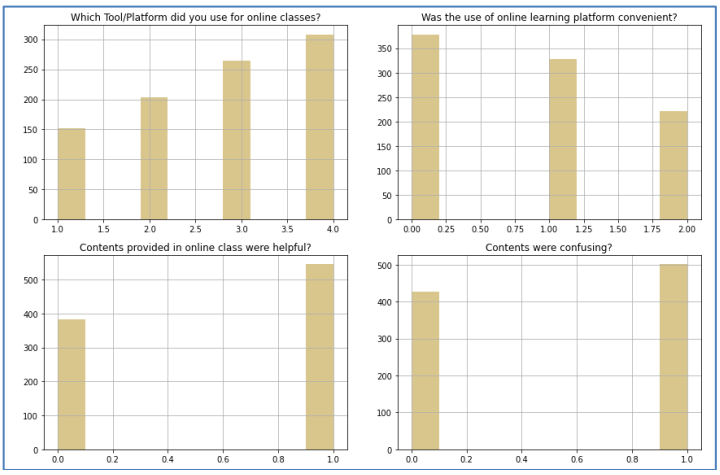
Model Training: In this phase of study, the training set was supplied to various models, In this study, the Logistic Regression, k-NN and Decision tree was tested in context of their accuracy of prediction. At the end of training the accuracy was 88.56%, 87.74%, and 86.41% respectively.

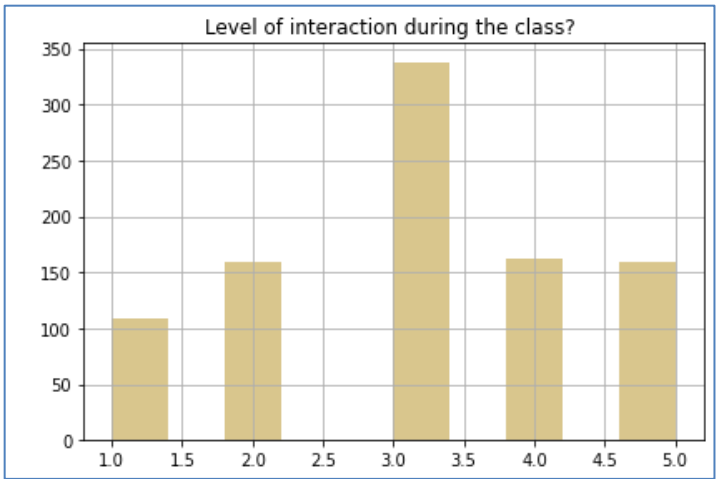
Model Testing: After training phase, the models mentioned above, were tested by supplying the same testing set to each model. The outcome was very interesting as the models performed well. The testing accuracy was 91.45%, 90.07%, and 90.02% of Logistic regression, k-NN and Decision Tree respectively.

RESULT AND DISCUSSION

Histogram: In the figure 2 given below, the histogram of each attribute is shown with their frequency of used values of each attributes. The X axis shows the number of possible answers and Y axis represents the answer frequency.







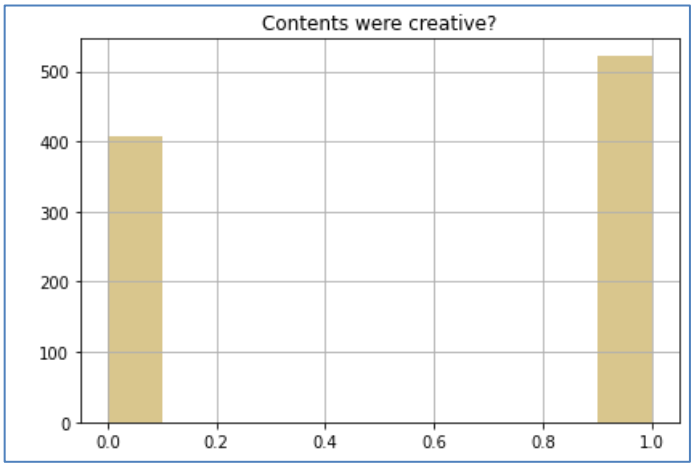
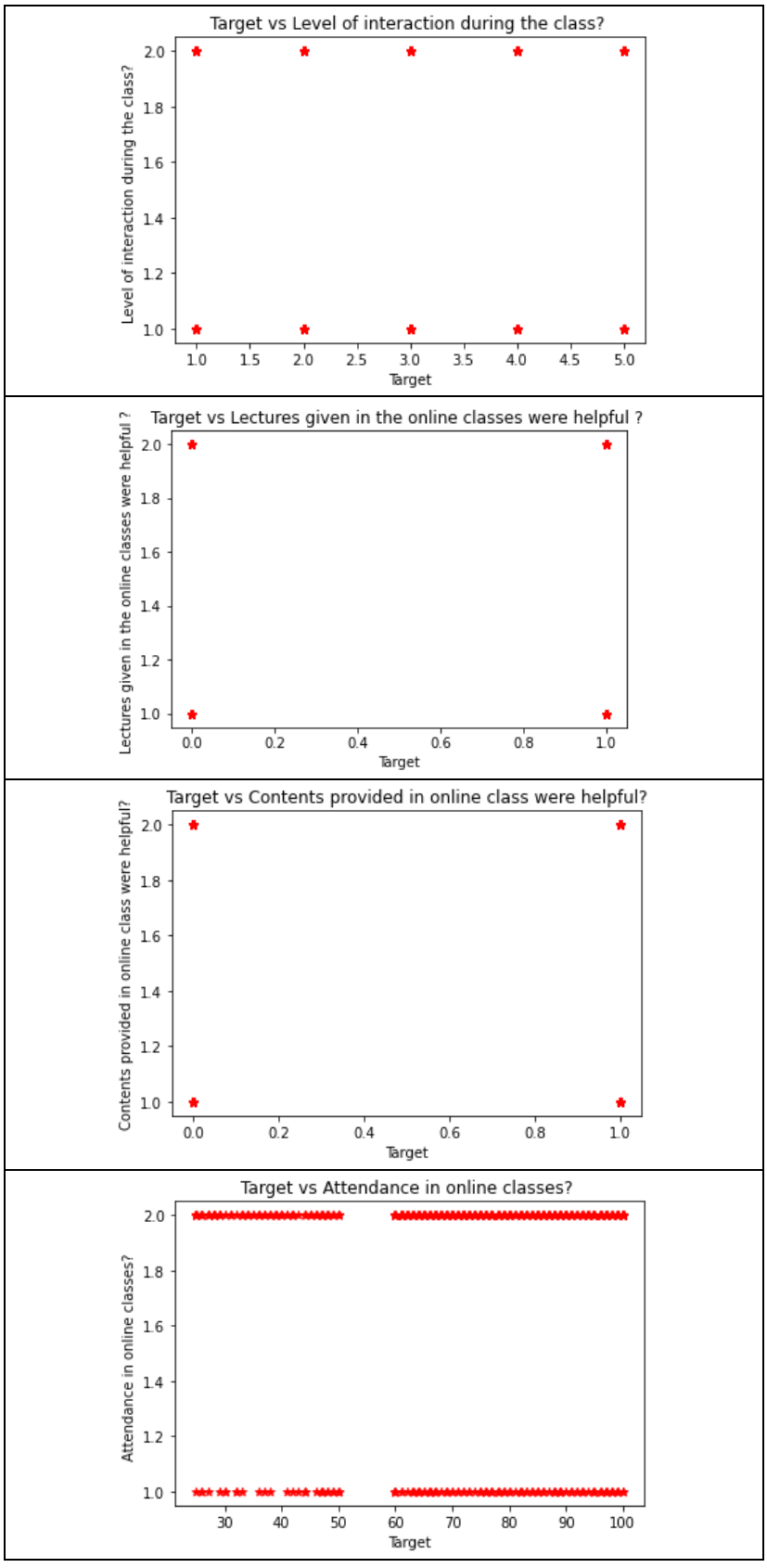


Fig. 2: Histogram of each filtered attribute

Feature detection after dataset split: After split the dataset, the features were extracted with the target variable shown in figure 3 given below:


Target vs Level of interaction during the class?
Level of interaction during the class?
Target
Target vs Lectures given in the online classes were helpful ?
Lectures given in the online classes were helpful ?
Target
Target vs Contents provided in online class were helpful?
Contents provided in online class were helpful?
Target
Target vs Attendance in online classes?
Attendance in online classes?
Target

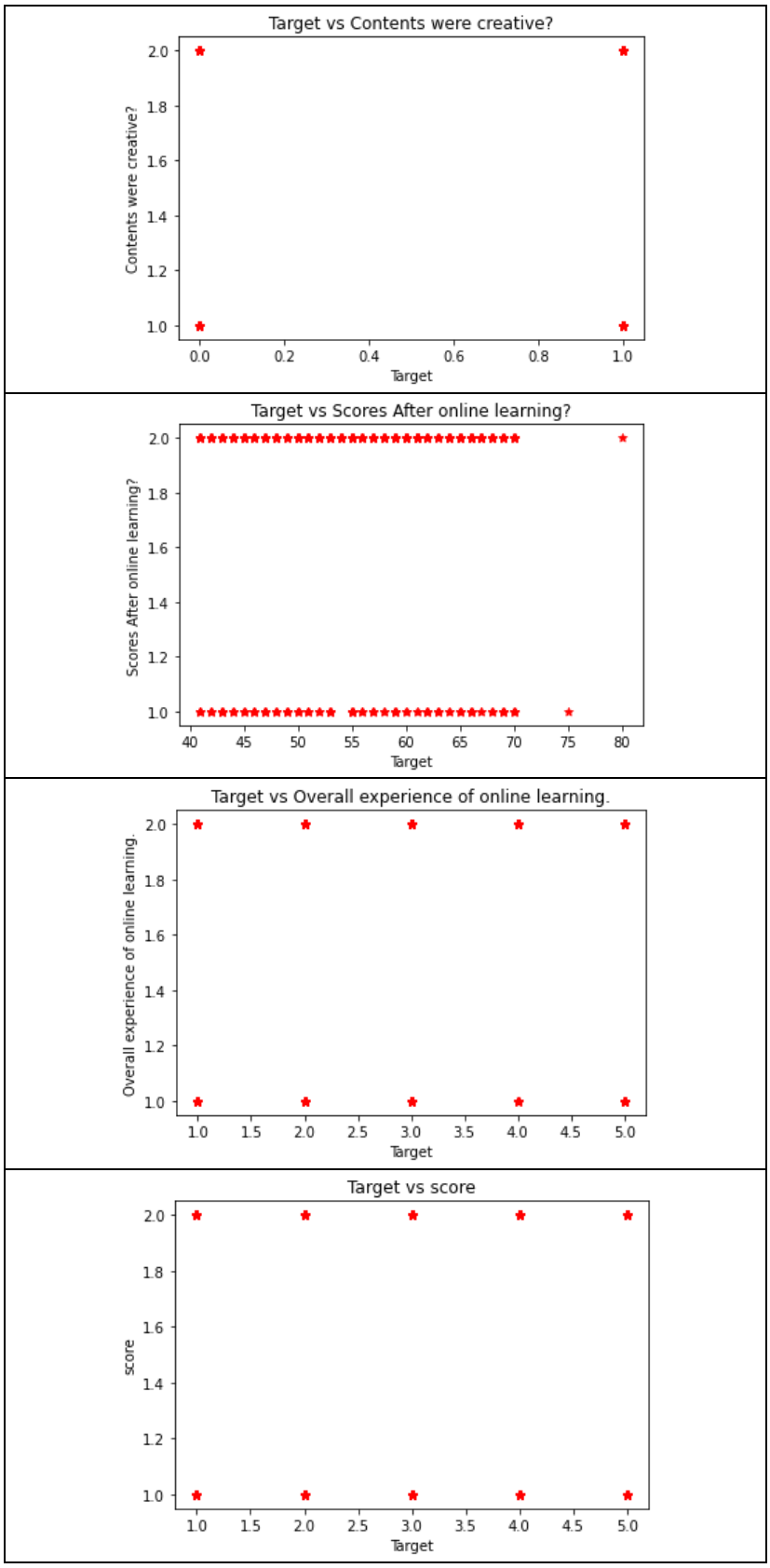


Fig. 3: Features extraction and compared with Target attribute

From above figure it is clear that the online system of learning encourages the interest of student towards the study but the distribute of features are nearly balanced with not interested students. In the context of scores, it can be seen that the scores achieved by the students are more impressive after online learning. It might be possible due to their convenience of taken exam or stress free examination.

Prediction Accuracy: In the table 3, the accuracy of various models are exhibited according to their performance on the same dataset. The table 3 contains the accuracy of models in terms of their training accuracy and testing accuracy.

Table 2: Models' accuracy comparison

Model	Accuracy	
	Training	Testing
Logistic Regression	88.56%	91.45%,
k-Nearest Neighbour	87.74%,	90.07%,
Decision tree	86.41%	90.02%

From the analysis of above table, it can be clearly seen that the Logistic regression was performed well in terms of training and testing as well. It achieves the higher accuracy during both training and testing. The k-NN and Decision tree also performed well during the testing and they competed well as their accuracy was 90.07% and 90.02% respectively.

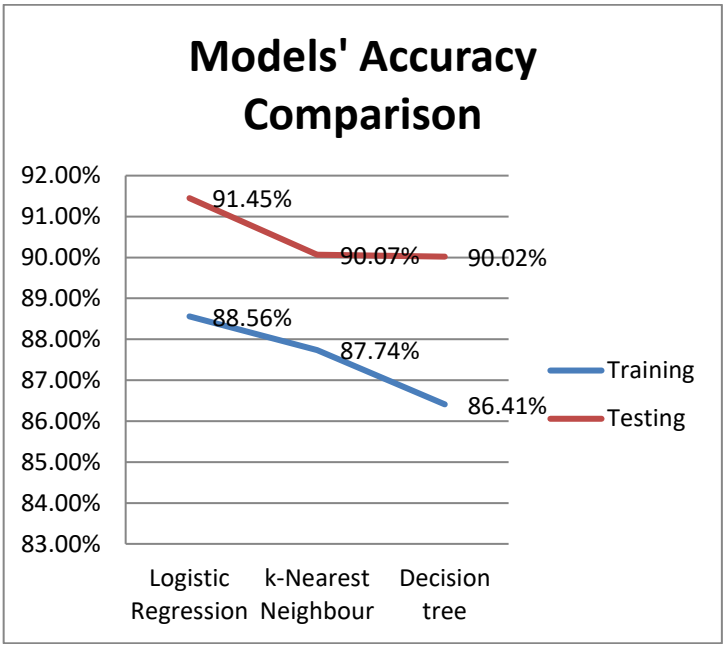


Fig. 4: Visualization of Models' accuracy

CONCLUSION

As of now, it is very important to get informed about the behaviour and reactions of students behind the online learning scheme. After this information, the future strategies can be made towards the E-Learning concept. After collecting the experiences of students in various ways of online learning, it is more important to digitize that data and explore the pros and cons of this strategy of teaching and for exploring the consequences, it is more important to select the best suited technology for this job. This study was mainly focused on the examination of various machine learning techniques in terms of their performance to analyse the overall performance of student in online learning during COVID-19 pandemic. In this study the actual data collected from the students who participated in online learning, are used to test the models accuracy of prediction. As the outcome of this study, the Logistic regression was performed well. The overall accuracy of training and testing i.e. 91.45% and 88.56% respectively is achieved by the Logistic regression. As of future scope of this study, this study can be directed to analyse the students' performance, students' behaviour analysis and to many more directions with the help of models prediction capabilities. Furthermore the performance of models' can be optimized in future studies.

REFERENCES

1. Motte-Signoret E, Labbé A, Benoist G, Linglart A, Gajdos V, Lapillonne A. Perception of medical education by learners and teachers during the COVID-19 pandemic: a cross-sectional survey of online teaching. Med Educ Online. 2021;26(1):1919042.

2. Li L, Wu H, Xie A, et al. Students' initial perspectives on online learning experience in China during the COVID-19 outbreak: expanding online education for future doctors on a national scale. BMC Med Educ. 2021;21:584.
3. Amit Kumar Arora , R. Srinivasan. Impact of Pandemic COVID-19 on the Teaching – Learning Process: A Study of Higher Education Teachers. Prabandhan: Indian journal of management; Volume 13, Issue 4, April 2020.
4. Elshami W, Taha MH, Abuzaid M, Saravanan C, Kawas SA, Abdalla ME. Satisfaction with online learning in the new normal: perspective of students and faculty at medical and health sciences colleges. Med Educ Online. 2021;26(1):1920090.
5. Jiang Z, Wu H, Cheng H, Wang W, Xie A, Fitzgerald SR. Twelve tips for teaching medical students online under COVID-19. Med Educ Online. 2021;26(1):1854066.
6. Basilaia G., Kvavadze D. (2020). Transition to online education in schools during a SARS-CoV-2 coronavirus (COVID-19) pandemic in Georgia. Pedagogical Research, 5(4), 10. https://doi.org/10.29333/pr/7937
7. Doucet A., Netolicky D., Timmers K., Tuscano F. J. (2020). Thinking about pedagogy in an unfolding pandemic (An Independent Report on Approaches to Distance Learning during COVID-19 School Closure). Work of Education International and UNESCO. https://issuu.com/educationinternational/docs/2020_research_covid-19_eng
8. Omar, Adnan & Kalulu, Daff & Alijani, Ghasem. (2011). Management of innovative e-learning environments. Academy Education Leadership Journal. 15.
9. Al-Rahmi, Waleed & Yahaya, Noraffandy & Alturki, Uthman & Alrobai, Amen & Aldraiweesh, Ahmed & Alsayed, Alhuseen & Kamin, Yusri. (2020). Social media – based collaborative learning: the effect on learning success with the moderating role of cyberstalking and cyberbullying. Interactive Learning Environments. 1-15.
10. Megahed, Mohammed & Mohammed, Ammar. (2020). Modeling Adaptive E-Learning Environment using Facial Expressions and Fuzzy Logic. Expert Systems with Applications. 157. 113460. 10.1016/j.eswa.2020.113460.
11. Shi S, Qin M, Shen B, et al. Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19 in Wuhan, China [published online ahead of print, 2020 Mar 25]. JAMA Cardiol. 2020;e200950. doi:10.1001/jamacardio.2020.0950
12. Mailizar, M., Almanthari, A., Maulina, S., & Bruce, S. (2020). Secondary School Mathematics Teachers' Views on E-learning Implementation Barriers during the COVID-19 Pandemic: The Case of Indonesia. Eurasia Journal of Mathematics, Science and Technology Education, 16, em1860. https://doi.org/10.29333/ejmste/8240
13. Abbasi S, Ayoob T, Malik A, Memon SI. Perceptions of students regarding E-learning during Covid-19 at a private medical college. Pak J Med Sci. 2020 May;36(COVID19-S4):S57-S61. doi: 10.12669/pjms.36.COVID19-S4.2766. PMID: 32582315; PMCID: PMC7306963.
14. Alalwan, Ali & Rana, Nripendra & Dwivedi, Yogesh & Algharabat, Raed. (2017). Social Media in Marketing: A Review and Analysis of the Existing Literature. Telematics and Informatics. 34. 10.1016/j.tele.2017.05.008.
15. Jadhav, Vikram and Bagul, Tushar D. and Aswale, Sagar R., COVID-19 Era: Students' Role to Look at Problems in Education System during Lockdown Issues in Maharashtra, India (May 5, 2020). International Journal of Research and Review 2020, Available at SSRN: https://ssrn.com/abstract=3935281
16. R.Radha, K.Mahalakshmi, Dr.V.Sathish Kumar, Dr.AR.Saravanakumar. (2020). E-Learning during Lockdown of Covid-19 Pandemic: A Global Perspective. International Journal of Control and Automation, 13(4), 1088-1099. Retrieved from http://sersc.org/journals/index.php/IJCA/article/view/26035
17. Dr. Pravat Kumar Jena. 2020. "Impact of pandemic COVID -19 on education in India", International Journal of Current Research, 12, (07), 12582-12586
18. Garbe, A., Ogurlu, U., Logan, N., & Cook, P. (2020). COVID-19 and Remote Learning: Experiences of Parents with Children during the Pandemic. American Journal of Qualitative Research, 4(3), 45-65. https://doi.org/10.29333/ajqr/8471

DOI: https://doi.org/10.15379/ijmst.v10i1.3689