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Preface

The 3rd International Conference on Computing, Communications, and Cyber-Security (IC4S-2021) held on October 30–31, 2021, at Krishna Engineering College (KEC), Ghaziabad, India. The conference covered the majority of the research papers from five technical tracks; it includes (i) Communication and Networks Technologies, (ii) Advanced Computing Technologies, (iii) Data Analytics and Intelligent Learning, (iv) Latest Electrical and Electronics Trend, and (v) Security and Privacy Issues. The main idea of the conference is to provide a common platform for the scientists, researchers, policy makers to discuss the novel ideas based on architectures, algorithms, surveys, policies, design, communication challenges, open issues, and future research aspects.

The conference was hosted by the Department of Electronics and Communication Engineering of Krishna Engineering College (KEC), Ghaziabad, India. The inaugural speech along with the welcome address was given by the director and joint director of KEC, Ghaziabad, followed by the address of general chair of the conference. The first keynote talk was delivered by Dr. Vandana Bassco, Department of Electrical and Electronics Engineering, University of Mauritius, Mauritius. The vote of thanks during the inaugural address was given by Dr. A. N. Mishra, Dean (SA) and HoD (ECE), KEC, Ghaziabad, and Local Organizing Chair of IC4S-2021. Two more keynotes were also delivered by Dr. Noor Zaman Jhanjhi, Director Center for Smart Society, School of Computer Science and Engineering, Faculty of Innovation and Technology, Taylor's University, Malaysia, and by Dr. Anand Paul, Kyungpook National University, South Korea. The conference was organized with the academic support of the Knowledge University, Erbil, Iraq; Southern Federal University, Russia; and WSG University in Bydgoszcz, Poland, along with IAC, India. Many experts from these institutions helped during the conference during call for papers, review, in preparation of program schedule, during technical sessions, and for other technical support activities.

We are highly thankful to our valuable authors for their contribution and presentations. The organizing team is thankful to the Technical Program Committee for their immense support during the review process. We express our sincere thanks to the organizing team for hosting the two-day event and conducting two-day sessions

very diligently. The IC4S-2021 team is thankful to all session chairs, who chaired the various technical sessions and provided wonderful suggestions to the authors. The session chairs have shared their technical expertise and enlightened the delegates of the conference during the paper presentation sessions. We express our sincere gratitude to our publication partner, Springer, LNNS Series, for believing in us.

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October 2021

Use of a Precious Commodity—'Time' for Building Skills by Teachers for Online Teaching During Pandemic by Using Decision Tree and SVM Algorithm of Machine Learning

Bharti Khemani, Jewel Sabhani, and Mala Goplani

Abstract The competency to perform a particular task effectively and efficiently is what we call a developed skill. Skills could be of any type: communication, leadership, interpersonal, problem solving, decision making, etc. This crucial period of the pandemic has brought along the threats and challenges and several opportunities with it. A chance to learn something new, think out of the box, be creative, convert our idle time into a quality one, etc. All this has given rise to using our time for some productive purpose. For months, we have been facing this pandemic, and 'Work from Home' is the policy adopted by almost every company, firm, and educational institution. And this has given all the employees working from home an opportunity to put their saved time into something innovative and productive. So, this study has emphasized the usage of time for skill development by teachers of the educational institutions of Mumbai for online teaching during the period of the COVID-19 pandemic through different training programs. This study is based on the primary data that has been collected from the teachers aged from 30 to 60 and above. Also, its results state that the skills which are required by the teachers for their effective teaching–learning process are developed successfully, and the majority of the faculties have improved their technical skills as well, which in turn have enabled them to adopt new and innovative teaching techniques.

Keywords Time · COVID-19 pandemic · Skill development · Online teaching · Decision tree · Machine learning · SVM · Classification

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1 Introduction

The COVID-19 pandemic has transformed traditional living into the online mode in every field, including teaching. It has made us adapt to all the changes and challenges that come across the path of success. This pandemic period has given the teachers of educational institutions several opportunities like learning to work online, engagement of students in virtual classes, making students learn to use different online learning platforms or LMS platforms to have easy access to virtual lectures and study material, students' virtual participation in various activities for their growth, etc. All this requires a teacher to develop new and innovative skills to perform better in the workplace. Also, there are several problems faced by teachers during the online teaching process, such as non-availability of a good Internet connection or electronic gadgets (laptop and computer), difficulty in operating the digital teaching applications (Zoom, Google Meet, etc.), providing online ready to use content to students, etc. These obstacles can be removed by developing required skills by teachers to conduct smooth online classes through faculty development programs (FDPs), refresher and training programs, short-term courses, webinars, workshops, etc. The study has elaborated the use of 'Time' (lockdown period) by teachers to develop their skills required for the online teaching process by attending training sessions or programs conducted by the institutes and different organizations. The study mentions the positive effects that a faculty gains after investing one's time in such training programs. A few of them are video streaming, downloading, video uploading, effective use of different LMS platforms or digital teaching platforms, easy and optimum use of excel, google drive, and Google Docs. It also highlights the interconnection between the skills that a faculty develops in oneself and their applicability into one's profession.

2 Review of Literature

The paper provides suggestions on teaching online courses that would result in more students' engagement and learning [1]. Practical aspects are considered for changing teaching strategies for a better online environment, including pre-preparing students, promoting learning through discussion boards, managing communication, incorporating multimedia, and evaluating the course. The paper highlights students' performance as measured by grade, which is independent of the instruction mode [2]. What is more challenging in research method classes compared to other public administration classes is 'persistence'? In addition to this, participation may be less pressurizing, and perhaps, quality and quantity of interaction be enhanced in online classes. The compelling circumstances of the overall COVID-19 pandemic and the subsequent lockdown made the institutions and the teacher–trainees dependent and involved them in the innovative teaching–learning methods [3]. This paper presents

the perspectives of teacher–trainees for the current transition to online teaching–learning methods and the influence or impact of the home environment on it during the lockdown imposed due to the COVID-19 pandemic.

The paper emphasized the impact of the COVID-19 pandemic on various sectors like business organizations, religious and spiritual bodies, educational institutions, functioning of households, etc., which made us decide about the changes we need to bring in our activities to 'survive'; therefore, we often try to find the solution for the problems that are associated with current and future time with the help of 'innovations' [4]. The same has been the case in our formal and informal learning mechanisms during this period of 'lockdown'. This paper analyzes the same through the observational study that involves how our education system has changed and its future success and failures.

3 Objectives

(1) To identify the different types of skills developed by teachers during the pandemic.
(2) To evaluate the no. of hours devoted to developing skills by attending different webinars, FDPs, orientation programs, refresher programs, etc.
(3) To analyze an interconnection between skills developed and teachers' profession (whether those skills can be applied to one's profession).
(4) To examine the positive effects of developing those skills in one's profession regarding promotion, salary hike, enhanced technical knowledge, etc.
(5) To analyze the degree of involvement in learning new skills to cope up with technological advancements.

Hypothesis

i. There is no association between the number of hours spent in a day and the technical glitches faced by the respondents.
ii. There is no relationship between age and the time spent in skills development.

4 Data Analysis

The number of faculties from colleges among women is 66 (66.67%) and that of males is 33 (33.33%), and the total is 99. Likewise, the number of faculties from schools, universities, and other categories like coaching classes among women is 4(75%), 3 (75%), and 2 (40%), respectively, and among males are 1(25%), 1(25%), and 3(60%), respectively. One hundred and thirteen responses were received in total, out of which 38 were males and 75 were females (Table 1).

From Fig. 1, it is clear 64.61% (73) of teachers aged between 30 and 40 years are found to spend the most significant number of hours enhancing their skills. And

Table 1 Number of responses in terms of gender and respondents profile

Gender/respondents profile	Male	Female	Total
College	33 (33.33%)	66 (66.67%)	99 (87.61%)
University	1 (25%)	3 (75%)	4 (3.55%)
School	1 (25%)	4 (75%)	5 (4.42%)
Other (coaching institute/private tuitions)	3 (60%)	2 (40%)	5 (4.42%)
Total	38 (33.62%)	75 (66.38%)	113

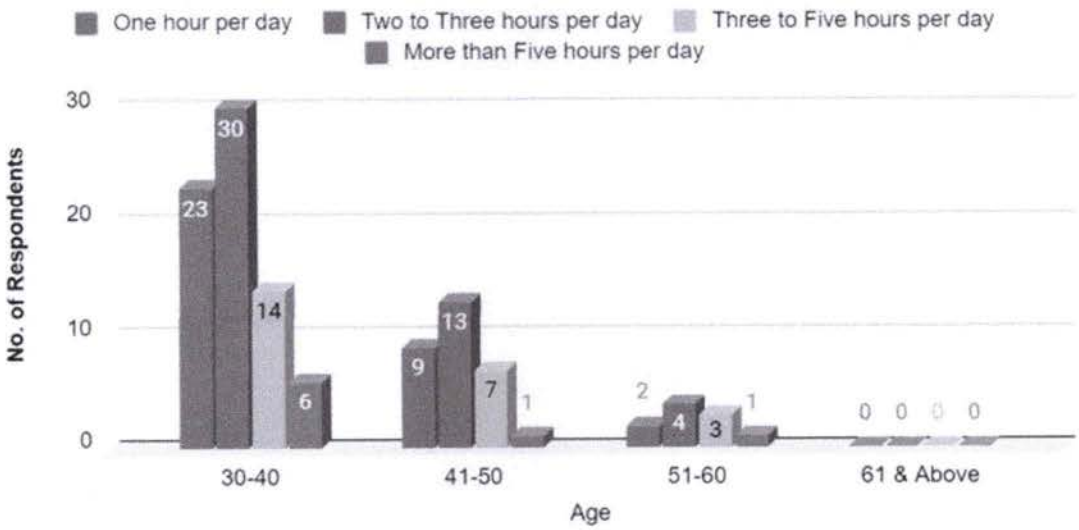

Fig. 1 Number of hours devoted by the respondents in terms of age profile

only 7.96% (10) of teachers aged between 51 and 60 responded that they spend very little time on skill development. From the age group of 30 to 40 years—30 people, from 41 to 50 years—13 people and from the age group of 51 to 60—4 people found to be spending 2–3 h per day which is maximum in all the categories. No one fell in the 61 and above age group criteria, which means that faculties belonging to 61 and above age group do not spend any no. of the hour for enhancing their skills.

From Fig. 2, it is clear that 103 teachers enhanced their skills of being able to engage their students virtually effectively and enhanced their presentation skills in the online classroom as well; 111 teachers developed the skills of using the different digital teaching applications like Zoom, Google meet, etc.; 99 facilitators developed their computer skills. Ninety-three of them developed listening skills, and 85 of them set their communication skills. Therefore, it was noticed that the teachers were found to have successfully enhanced their skills by attending these different training programs.

It is clear from Fig. 3 that the maximum number of hours devoted by the faculties is on webinars. It also observed that the maximum number of faculties used to spend 2–3 h on different programs, viz 40 in FDPs, 47 in webinar, 30 in orientation programs, 19 in refresher programs, 31 in short-term courses, and 34 got in-house

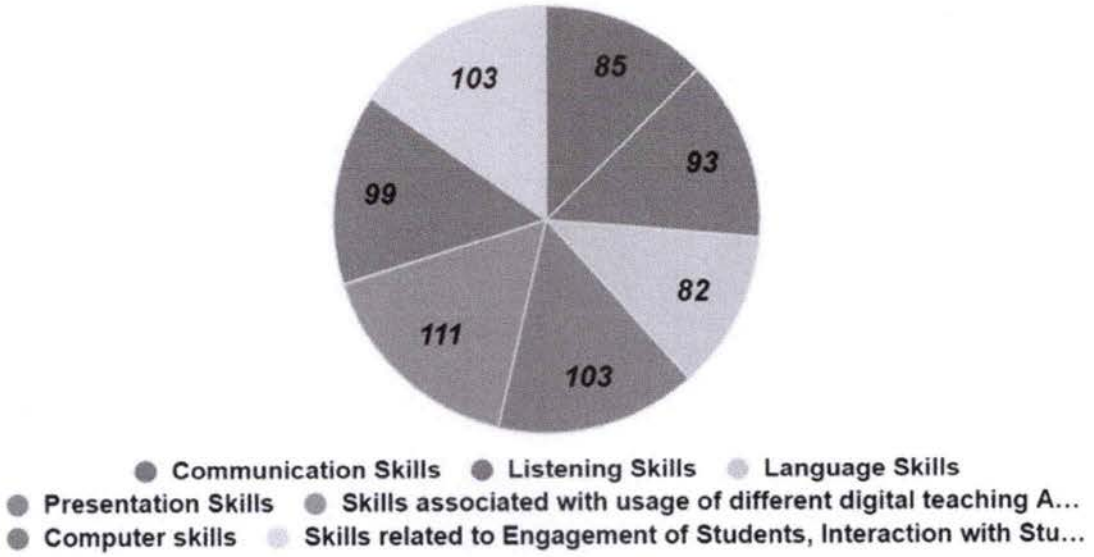

Fig. 2 Skills developed after undergoing refreshers/orientation programs, FDPs, webinars, etc.

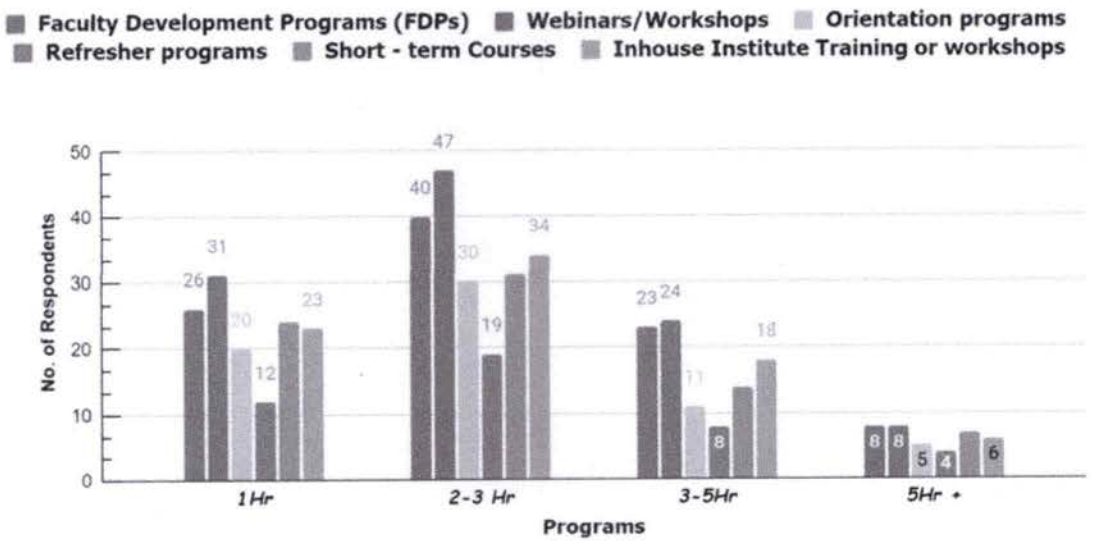

Fig. 3 Number of hours devoted by the respondents to attending different programs

training. However, very few teachers are found to be spending 5 h and above in various training programs.

From Fig. 4, it is clear that 111 faculties, i.e., 98.23%, have improved their technical knowledge, 105 teachers achieved greater flexibility in the teaching–learning process and also learned the techniques of an innovative and engaging way of teaching and assessment; 109 (96.46%) faculties have gained insights for using their innovative teaching–learning tools and materials, while 110 teachers learned about different digital tools for online learning. One hundred and eight faculties improved their skills related to online content development.

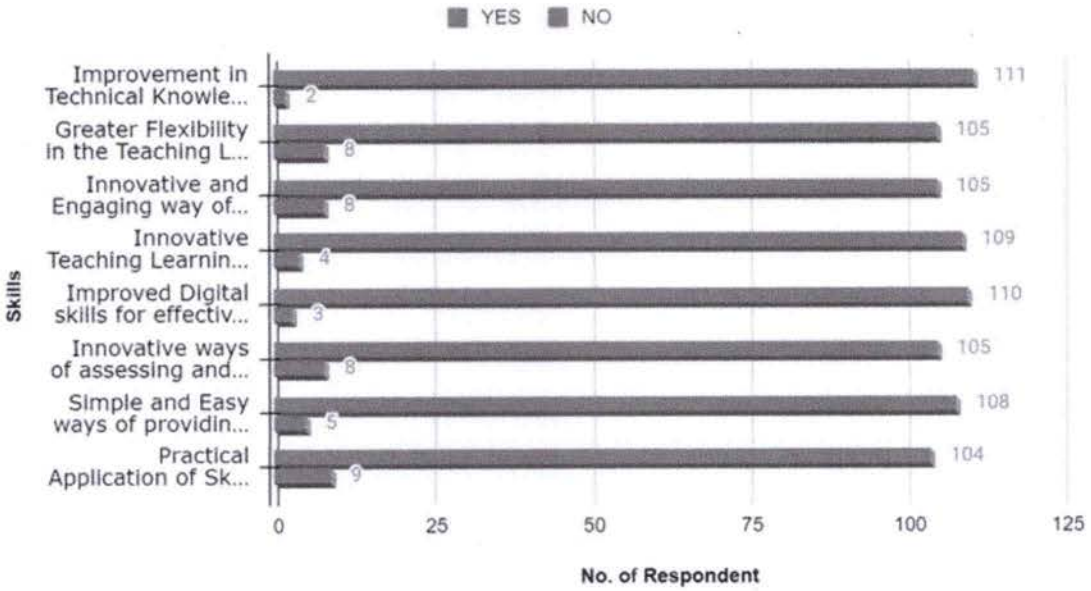

Fig. 4 Positive effects of developing the skills

It has been observed from Fig. 5 that 55 faculties have been facing the problem of the availability of digital equipment (phone/laptop/computer), whereas 38.26% of the respondents do not face any problem related to equipment. Likewise, 76.16% of the respondents have faced the issue of less face-to-face communications and interaction during the online programs. Fifty-eight respondents expressed that their mental health has deteriorated because of online training because they had to spend more time learning such skills. Sixty-eight (60.18%) of respondents agreed that they

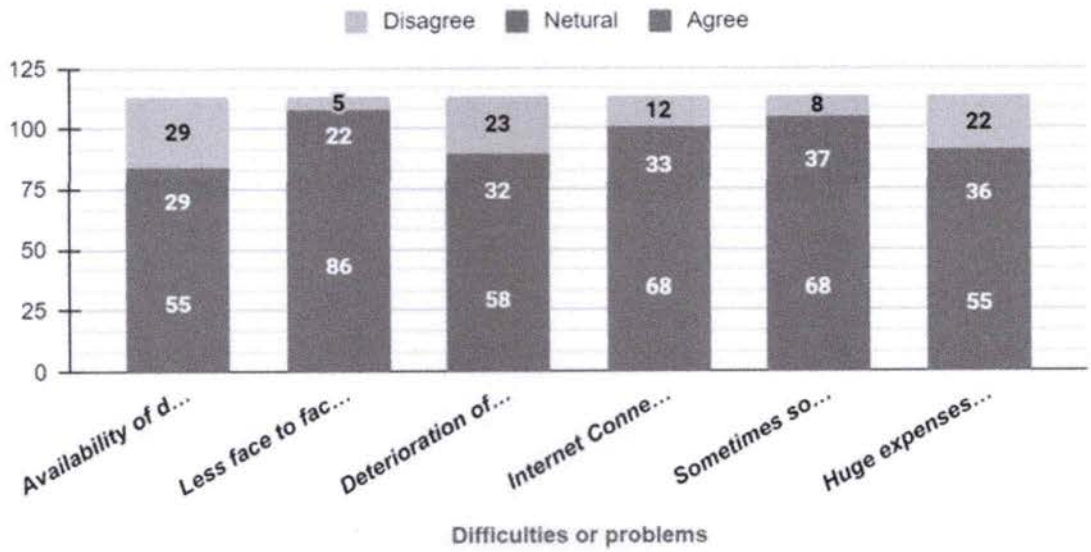

Fig. 5 Difficulties or problems faced by the respondents for developing skills through FDPs, webinars, refresher programs, etc., during COVID-19 pandemic

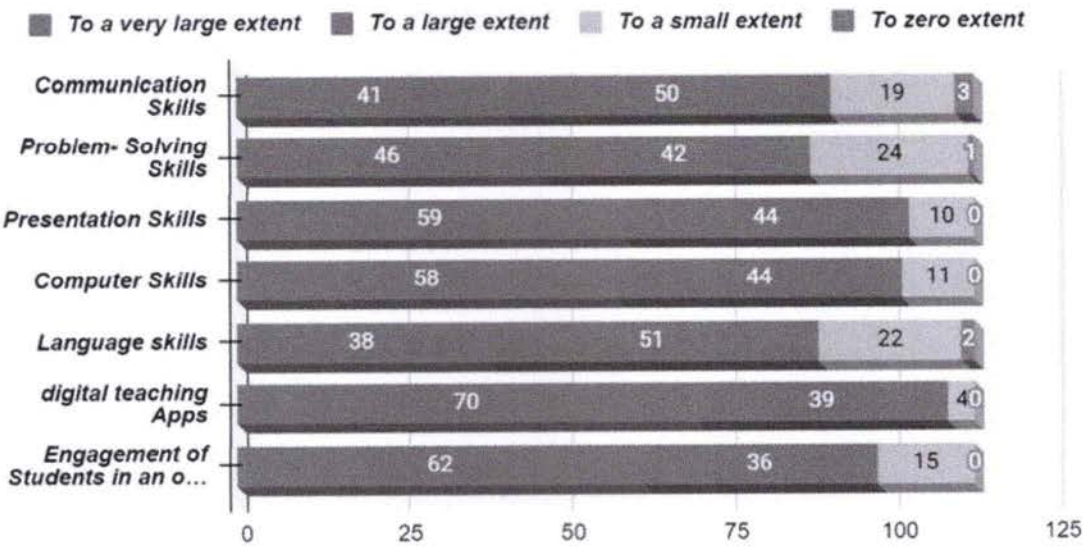

Fig. 6 Extent of applicability of these developed skills in the teaching–learning process

had faced Internet connectivity issues, and 55 agreed that they had spent more on getting a good Internet connection.

It has been noticed from Fig. 6 that a maximum of 70 respondents (61.94%) have agreed to a very large extent that they have developed their skills in digital teaching applications. In contrast, very few, i.e., only 38, agreed to a very large extent that they have developed language skills through these programs. The majority of the respondents, i.e., 50, 42, 44, 44, 51, 39, and 36, believed to a large extent that they developed their communication skills, problem-solving skills, presentation skills, computer skills, language skills, digital teaching applications, and engagement of students in an online class, respectively. However, very few fall under the zero category.

Figure 7 shows that because of the development of required skills during the pandemic, there is a vast and positive impact on different activities conducted during the online teaching process. 93.80% of faculties have started taking quizzes. Seventy-two teachers are engaging their online lectures with the help of gamification methods. Again 95.58% of faculties are taking their online classes with the help of PPTs. 92.03% of teachers are sharing the videos for a better understanding of the topics. Only nine seemed to disagree with this. One hundred and five faculties involve their students in different virtual activities.

It has been seen from Fig. 8 that the majority of the respondents have got positive outcomes by attending the different workshops and training programs for their skill development. One hundred and five respondents agreed that they had learned the techniques of smooth online lecture delivery (Microsoft Teams,

Google Meets, Zoom, etc.) followed by 103 who learned the techniques of innovative and easy assessment and evaluation. For the video editing and compression and video hosting, streaming, and downloading, 78 respondents got a positive outcome. Ninety-nine respondents (87.61%) have learned the techniques of optimum utilization of Google Drive (For Reports, Content, etc.)

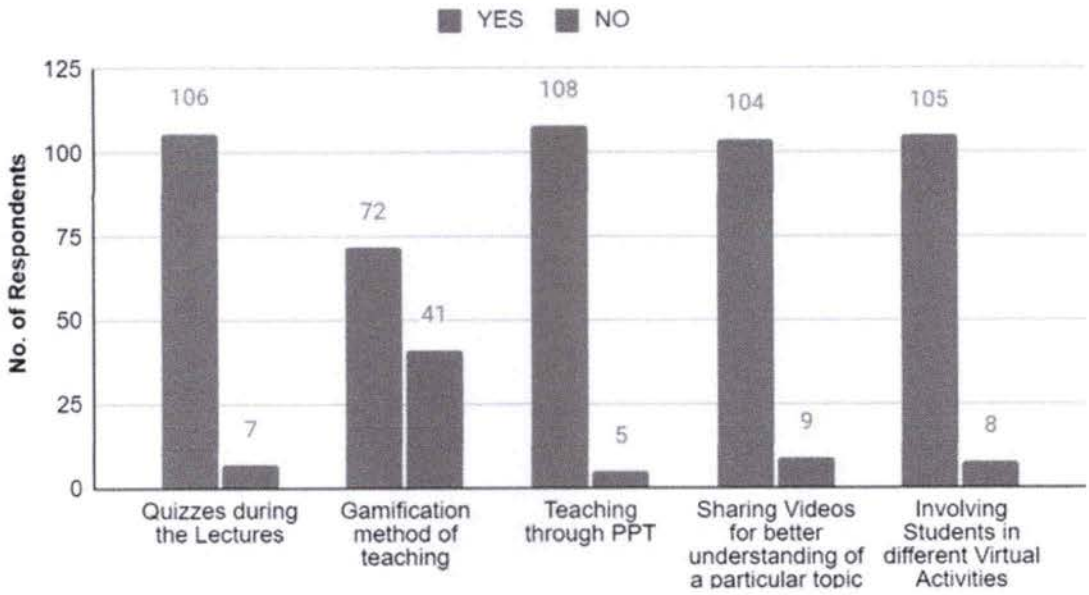

Fig. 7 Activities carried out by faculties for students in the online teaching process

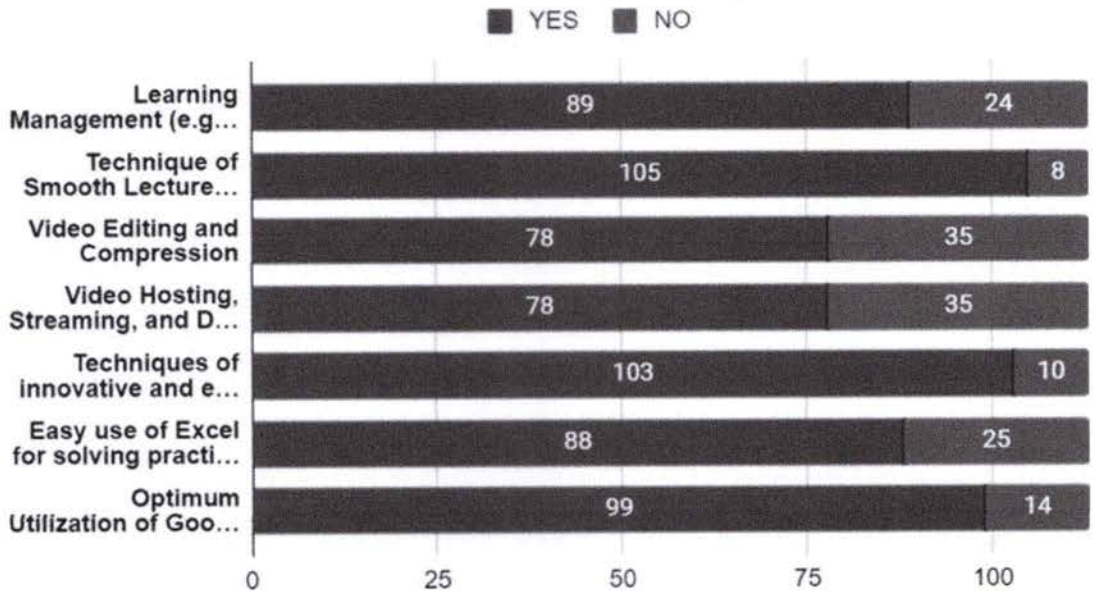

Fig. 8 Highlights of the outcomes from FDPs, webinars, workshops, professional courses, etc.

From Fig. 9, out of 113 respondents, majority, i.e., 72.6% respondents, selected the blended teaching–learning method, which should be adopted to keep a balance between online and offline teaching methods, followed by only 18.6% who agreed to continue with online teaching as it is easy and convenient after learning all new required skills and very few (8.8%) selected the traditional chuck duster method of teaching as they believe it is far better than the online method. It can be predicted easily that currently, the faculties prefer more blended teaching for their teaching–learning process.

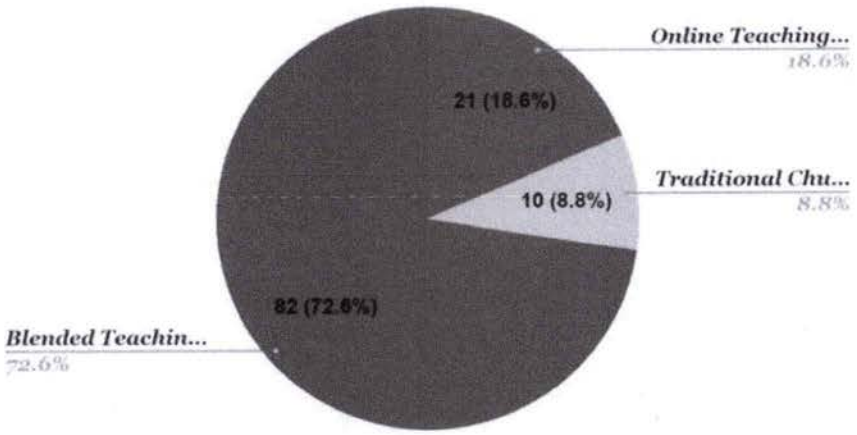

Fig. 9 Most effective and chosen way of the teaching–learning process

5 Classification Algorithm of Machine Learning

This paper uses decision tree (DT) and support vector machine (SVM) algorithms. From Fig. 10, we can see we divided the whole data into two sub-parts, i.e., training and testing, with the help of algorithm, we calculated the accuracy, and DT and SVM have supervised learning algorithms. Both learning methods are used for classification and regression tasks, but we have used both algorithms as classification

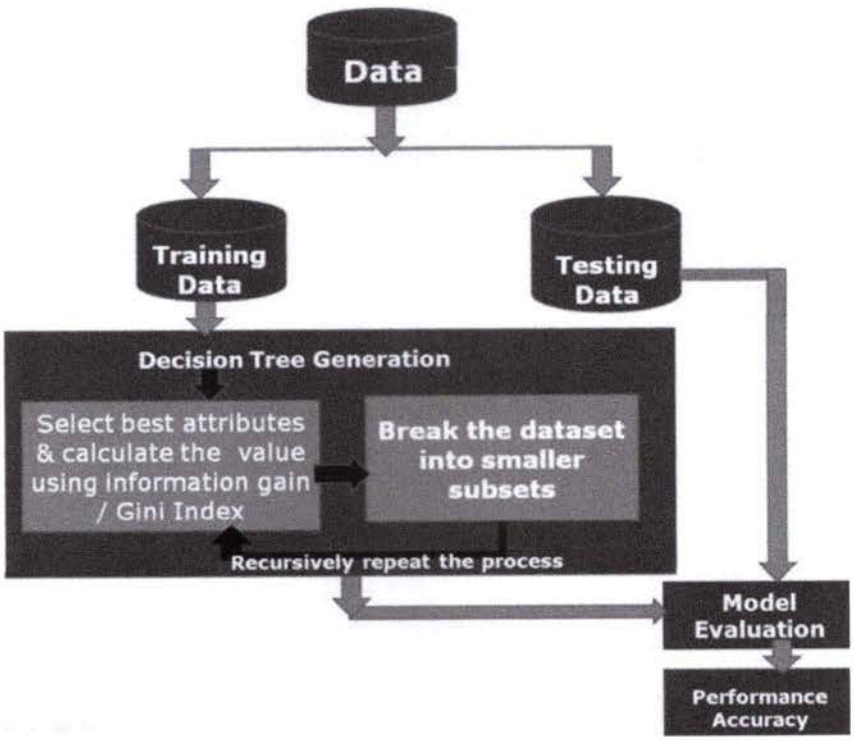

Fig. 10 Flow of classification algorithms

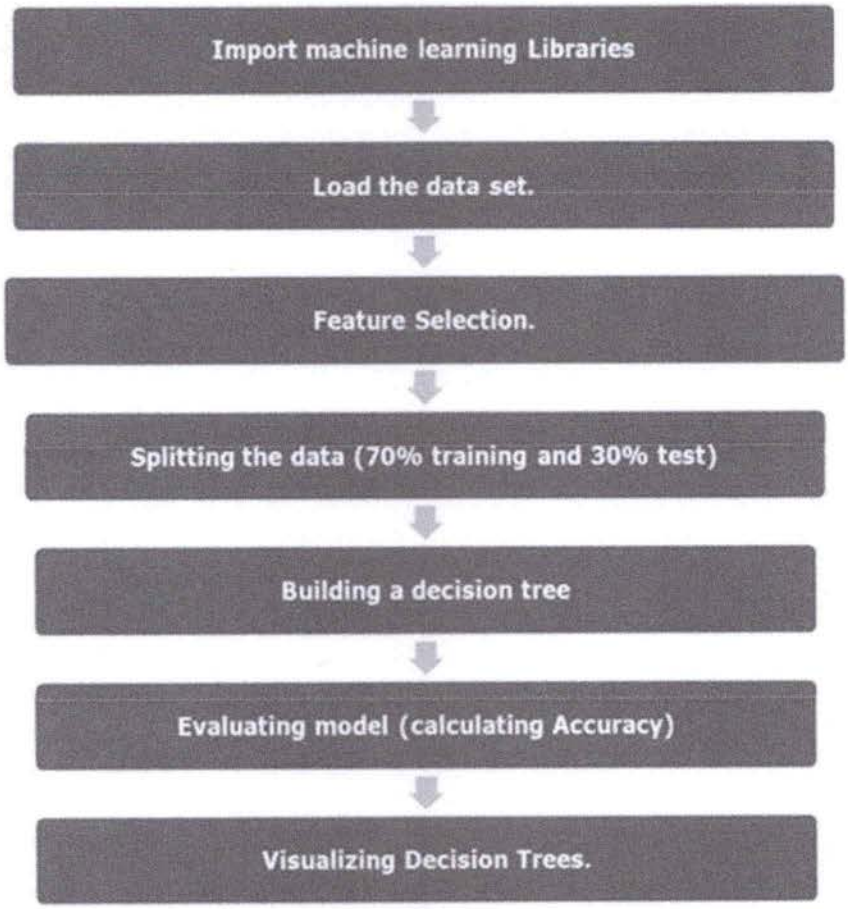

Fig. 11 Steps for an algorithm

algorithms in this paper. Classification is a two-step process: learning step and prediction step. In the learning phase, the model is developed based on given training data. In the prediction step, the model is used to predict the response for shared data. Figure 11 shows the steps of algorithm. We divide our dataset into seven steps to get an output (Fig. 12).

From our whole data, we have considered some columns such as age, learning programs attended, digital devices used, personal benefits, problem faced, and online platforms as features columns (input) and numbers of hours devoted as a label field (output). And found that we are getting 76.47% accuracy with both the algorithms. For splitting, the most popular criteria are 'Gini' for the Gini impurity and 'entropy' for the information gain that can be expressed mathematically as $E(s) = \sum -$ pi log 2 pi. In Fig. 13, class 1 indicates that the number of hours devoted by respondents is one to three hours per day, whereas class 2 shows that the number of hours devoted is more than three hours per day. We can see from Fig. 13 that if age is between 30 and 45, people attended more no. of programs like FDP/workshops and many more. They have good Internet connectivity (not facing any problem), and then the person belongs to the class 1 category. On the other hand, we also noticed from Fig. 13 that if the age is between 30 and 45, people attended more no. of programs like

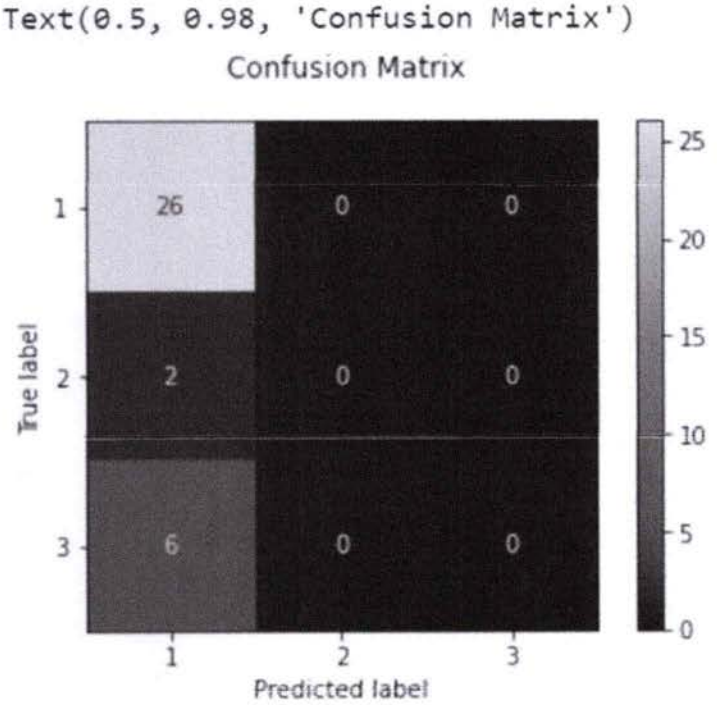

Fig. 12 Confusion matrix of decision tree and SVM

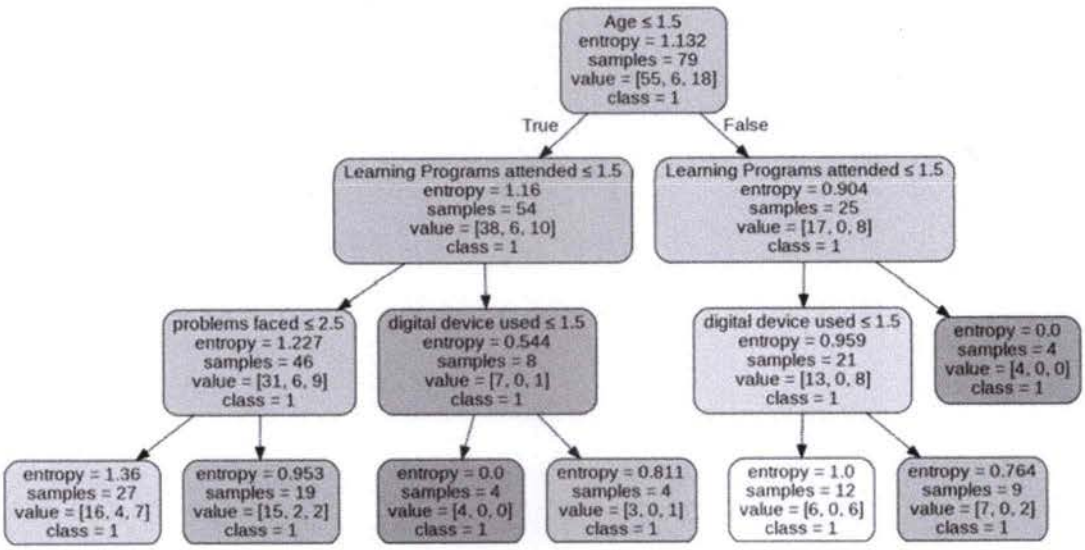

Fig. 13 Output of the decision tree algorithm based on the hypothesis defined in Sect. 3

FDP/workshops and many more. And if they have digital devices available, then the person belongs to the class 1 category.

Confusion matrix is used to know the performance of a machine learning classification. It is represented in a matrix form.

FN: The false negative value for a class will be the sum of values of corresponding rows except for the TP value.

FP: The false positive value for a class will be the sum of values of the corresponding column except for the TP value.

TN: The true negative value for a class will be the sum of values of all columns and rows except the values of that class that we are calculating the values for.
TP: The true positive value is where the actual value and predicted value are the same.

The confusion matrix for the IRIS dataset is as below:

TP: The actual value and predicted value should be the same. So class1, the value of cell 1, i.e., 26 is the TP value. It says that 26 people have invested their time for learning different programs.
FN: The sum of values of corresponding rows except the TP value FN = (cell 2 + cell3) = (0 + 0) = 0.
FP: The sum of values of corresponding column except the TP value. FP = (cell 4 + cell 7) = (2 + 6) = 8.
TN: The sum of values of all columns and row except the values of that class that we are calculating the values for. TN = (cell 5 + cell 6 + cell 8 + cell 9) = 0 + 0 + 0 + 0 = 0.

6 Conclusion of Hypothesis Based on This Decision Tree

Hypothesis

1. There is no association between the number of hours spent in a day and the technical glitches faced by the respondents.

As we can see from Fig. 13, the number of problems is more ($\leq$2.5), so it belongs to the class 1 category, which means the person has devoted less number of hours due to more no. of problems. Therefore, we conclude that the null hypothesis is rejected.

2. There is no relationship between age and the time spent in skills development.

As we can see from Fig. 13, a person's age is less ($\leq$1.5), which indicates the age group between 30 and 45. So, it belongs to the class 1 category, which means the respondents belonging to the young age group have devoted more hours to developing their new skills. Therefore, we conclude that the null hypothesis is rejected.

Based on different features (age, online platform, problems faced, no. of samples considered) of the data set, entropy is calculated, and output (no. hours devoted) is classified as 1 and 2.

7 Findings

1. Most teachers learned how to use digital learning applications by attending different skills development programs during the pandemic that they had not used previously.

2. Most of the teachers became technical experts in different fields.
3. Skills related to engagement of students, interaction with students, etc., by using different tools like gamification sharing videos and taking quizzes in between are developed through these programs.
4. Teachers learned new innovative ways of assessing and evaluating students' performance.
5. Most of the teachers have faced the problem in online teaching for the students' involvement and face-to-face communication.
6. The use of Excel has increased many folds as for the practical subjects, and teachers have started teaching and solving their practical questions in excel.
7. Teachers have also developed their skills of keeping all the essential information in Google Drive.
8. Most of the teachers have chosen the blended teaching method for their teaching–learning process.
9. There is a strong association between the age factor and the number of hours devoted by the faculties on various skill development programs.
10. There is a strong association between the technical glitches and the number of hours devoted by the faculties to various skill development programs.

8 Suggestions

1. Colleges or institutes should give time-to-time training their faculties and students to develop such skills to enhance their teaching–learning process smoothly.
2. Some teachers face problems when it comes to technology. For faculties, detailed training should be provided by the institute itself.
3. The study is restricted to the persons who are teachers by their profession and residing in Mumbai Suburban only.
4. The age group below 30 is also to be considered for this study.
5. The data is fetched from a small sample population, so the results may not be applied to the whole population.
6. Teachers should get resources like laptops/computers from the college to become more efficient in using ICT tools.
7. When teachers come up with unique ideas for the students' engagement and development, then college should appreciate their efforts in the different forms that will motivate faculties to add on more skills.
8. Whatever expenditures are incurred by the teachers for attending these workshops or programs, the colleges should reimburse training amounts to their faculty members.
9. The accuracy of the data can be improved if the size of the data set increases.

9 Conclusion

'Online' is something that lies at the core of everything we do during this pandemic. Educational institutions have also adopted online education as a mode of imparting education to children. This requires a significant number of efforts and skills by the teachers to maintain quality education. This study reveals that the teachers have invested their precious time for their skill development by attending various webinars, workshops, FDPs, orientation/refresher programs, etc. It is noticed that the faculties have developed the number of skills that are required in teaching–learning process, viz communication skills, language skills, listening skills, presentation skills, skills associated with the usage of different digital teaching apps (Zoom, Google Meet), computer skills, skills related to virtual engagement of students, interaction with students, etc. The age group of 30–40 years has been spending two to three hours per day developing such skills by means of webinars in the majority, followed by FDPs. It is also observed that the number of faculties from colleges participating in such skill development programs among women is relatively higher than that of males. After devoting a good number of hours, faculties have developed the skills of using different digital teaching apps (Zoom, Google Meet), presentation skills, virtual engagement of students, and interaction with students the most. And these skills are found to apply in the teaching–learning process to a very large extent. The positive effects of developing such skills are improvement in technical knowledge, greater flexibility in the teaching–learning process, and usage of innovative teaching–learning tools and materials that have become easy. It has also been noticed that even after devoting a great amount of time to developing these skills, the majority of the faculties are not paid the required salary, not given any salary hikes, nor are they promoted. The faculties have been facing difficulties while undergoing such programs as unavailability of digital equipment, low Internet connectivity issues, deterioration of mental health due to overtime, etc. Despite facing many such problems, the faculties are found to be devoting their precious time to developing the required skills.

Apart from these difficulties, most of the faculties have gained more insights into the technology during this pandemic and have learned many innovative teaching techniques. Thus, the majority of them (72.6% respondents) chose to continue with blended teaching methods as their way of teaching in the future as well (post-pandemic).

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