



# Performance Comparison for E-Learning and Tools in Twenty-First Century with Legacy System Using Classification Approach

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## Abstract

In recent times, Covid-19 has changed the dimensions of the educational industry. Universities across the global are focusing on the changing trends, technologies, and practices influencing the teaching and learning among teachers and students. This research paper mainly focuses on the emerging technologies in the Covid-19 providing about the real-time examples and insight the brief about the transformational shift how the universities are architect the various ecosystems both for instructors and learners. The relevant dataset of exam, quizzes, etc., from heterogeneous department were utilized for proposed methodology. The research work also includes the implications and challenges faced by the universities while implementing these technologies. The accuracy obtained was higher in the twenty-first century e-learning tools and lesser in all other cases as well as for the legacy system. The performance was observed, and various inferences were discussed with the effective delivery of the teaching material and their issues.

## Keywords

Machine learning • Random forest • SVM • Emerging technologies • Changing educational dimensions • NB • KNN • Covid-19 • Pandemic • E-learning

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## 1 Introduction

### 1.1 Adaptive Learning Technologies

Over the years, the teaching pedagogy is mainly teacher centric. Technology has changed into the student-centric approach of learning. The present concept of the learning includes adaptive learning technologies. Today, many universities have the adoptive systems to assist students in the learning activities. These technologies help the instructors to evolve as the mentors and leaders of the classroom teaching from the content delivery in the form of the lectures. These technologies also help students to access only to those resources which are directly available to them. Adaptive technologies also act as the supporting tool for the flipping classroom. Using the adaptive system, students can easily learn using Bloom's taxonomy using the remembering and understanding aspects. Then by using the flipped classroom technology, students can easily focus on the remaining levels of Bloom's taxonomy. This helps instructors to effectively organize the activities in the active classroom processes.

### 1.2 Open Educational Resources

The UNESCO defines that educational resources (OER) are learning, teaching, and using various materials which are openly available for students and teachers. OER includes presentations, videos, lessons, full text materials, articles, podcasts, and other learning materials. These materials are copyrighted in the various open sources and then are published in the various public domains. The major purposes of OER are retain, reuse, remix, revise, and redistribute. Retain includes where the learning materials can be retained by the students anytime and anywhere. Reuse includes the content can be modified by teachers and students. Remix includes the generation of new ideas using the existing content. Revise includes modification and alteration of the content

due to specific needs and redistributing includes content which can refer, shared in any format. The major advantages of the OER are first, assurance of the quality; while accessing the OER educators can collaboratively to improve the quality of the materials, second, development of the career; educators can access the new ideas and enhancements of the careers.

Based on these Rs, many universities are adapting various strategies to implement the OERs in the curriculum. Various incubators are using open education resources to bring instructors and students for developing the competencies in teaching pedagogy. OER has improved collaboration among instructors and learners by hands-on workshops, curated readings, and cohort discussions.

### 1.3 Analytics in Education

Over the years, many universities have majorly focused on the implementing the various strategies for promoting the better practices in teaching–learning modules. Gradually, universities are shifting toward the measurements, collection of data, analyzing the students' progress using the learning analytics tools. Learning analytics approaches for better understanding and support learning systems. Student analytics are been retrieved from the various learning management systems (LMS), customized university-level student information systems, institutional-level enterprise resource planning systems which includes financial records and research updates. As learning analytics becomes more important role for universities for strategic planning at institutions around the world. These include a range of practices which are including data privacy, equity, and ethical considerations.

Last 10 years, institutions have used analytics for functional support of the organisations which include enrollment, student management status to general student progress. Earlier, they are less used for assessing student learning outcomes. Present, many universities are focusing on the institutional accreditation, which is now being accompanied by analysis of student engagement and student performance data. The present shift of analytical technologies has redrafted vision of the global universities to achieve the student goals and policies.

The major advantages of the analytics are students can easily track and access the individual data and analyze the progress by themselves.

### 1.4 Machine Learning in Education

In the current era, the ML-based tools for analytics that can be applied and various predictive measures can be obtained

by using this. The various predictive analytics that can be done are related to the examination, learning outcomes, etc. The amount of time the students spends over online learning can also be analyzed, and predictions can be made as how good enough the learning happens while the students learn over the Internet in live classes. Various algorithms help to improve the learning and analyze how to improve the learning. The performance-based methods can also be applied so as to increase the learning and to develop the e-learning strategies.

*Challenges of emerging technologies with in the higher education.*

Many of the technologies have the various challenges as many of the technologies are in the embryotic stages in the higher education. Many technologies still have two major problems: first, cost. These technologies have major cost-related problems which includes, designing of the curriculum, preparation of the content, and redesigning evaluation pattern, and finally, the biggest challenge is the privacy of the data, as it is available in the free of cost. As many technologies are widely changing the perspective, still major challenge persists that lack of sufficient, continuing professional development for understanding the usability among teachers. Another major challenge is to majority of the learning is focusing on the informal learning rather than formal learning using these technologies.

## 2 Literature Review

Avella et. al. mentioned and discussed the various aspects of the online teaching and learning in higher education (Avella et al., 2016). Rana et.al. discuss regarding the issues and challenges in e-learning (Rana & Lal, 2014).

Tjhin and Kuchma (2002) they have discussed the computer-based radius designing methods.

Kearns (2012) have focussed their studies to assess the student performance with respect to the challenges associated to get the effective practices in teaching and learning process.

Dabbagh and Bannan-Ritland (2005) they have found the various online learning concept and how to put these strategies in the form of application and how to achieve the great learning experience manjot Kaur (2013) also found that the various learning challenges in a blending approach (Chatti et al., 2012; Dietrich & Langley, 2007; Moubayed et al., 2018). By delivering high-quality instructional information to students around the world, MOOC (Sharma & Shrivastav 2020; Pietquin & Lopes, 2014; Woolf, et al. 2013; Xiong & Suen 2018) also provides an ultimate way to provide digital content in higher education environments (Daniel 2015; Sharma et al., 2015). A new research agenda focused on forecasting and describing student dropouts and

poor retention rates in MOOCs have arisen, despite the gaps between conventional learning paradigms and MOOCs. We give a description of the prediction phenomena of MOOC student dropouts where machine learning approaches have been used.

In addition, they highlight some strategies that are used to solve the issue of dropout provide an overview of the problems of prediction models and provide some useful perspectives and suggestions.

Daniel (2015), Sharma et al., (2015) Higher education institutions work in an extremely diverse and competitive environment. It examines current issues facing higher education institutions around the world and discusses big data's ability to overcome these issues. In the sense of higher education, the paper also discusses a range of benefits and problems associated with integrating big data. It ends by developing potential strategies for growth and execution.

### 3 Methodology

The methodology section Fig. 1 describes the data processing performed on the data collected from the attendance, exam, quiz, and results and online and offline comparative data for the study. The ML algorithms discussed were used to perform the study, and Tables 1 and 2 show the error estimates and the performance ratio obtained on that data after applying the algorithms. The performance calculation was performed, and result obtained was studied after applying various algorithms.

Hence, the analysis indicative is for the better delivery and enhanced interactive learning in the twenty-first century e-learning environment. That is also inclusive of the dynamic availability of the participant's w.r.t. timing of the lectures as well. Figures 1 and 2 show the resultant performance chart. Now the various big MNCs also focusing on work from home life-time opportunities for their employees at the convenience at their doorstep. It will certainly boost the economy of the country.

#### 3.1 Dataset

The dataset includes the records fetched from the university exams from various departments (compiled by individual faculty members). The dataset collected from the faculties while preparing the results during Covid-19 and before the pandemic time as well. The dataset then used for preprocessing and the available data outliers, and other errors were removed and data filtering were also applied to remove and cut short the irrelevant data.

Total of 1400 records were used for training the model, and 670 records were used to test the model. The data feed

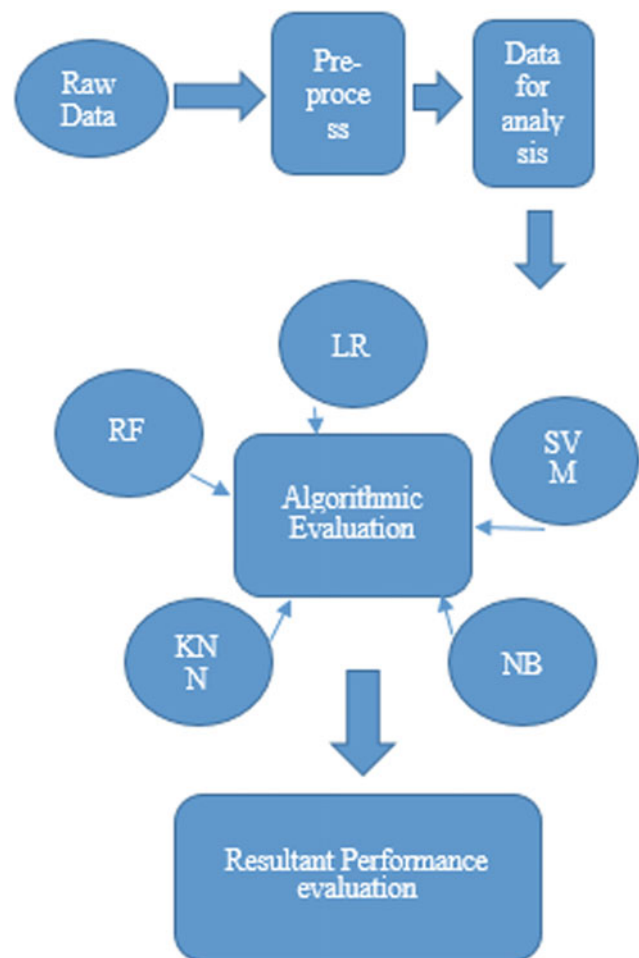


Fig. 1 Detailed methodology

into the system and the algorithms used to test the results on these dataset. The algorithms were used like linear regression, support vector machine, K-nearest neighbor, naïve Bayes, and random forest. The performance evaluated for these algorithms and discussed separately in the result section of this research article at the results and discussion section. Accuracy obtained for the random forest was the highest while compared to all the other algorithms used.

## 4 Results

### 4.1 E-Learning Twenty-First Century

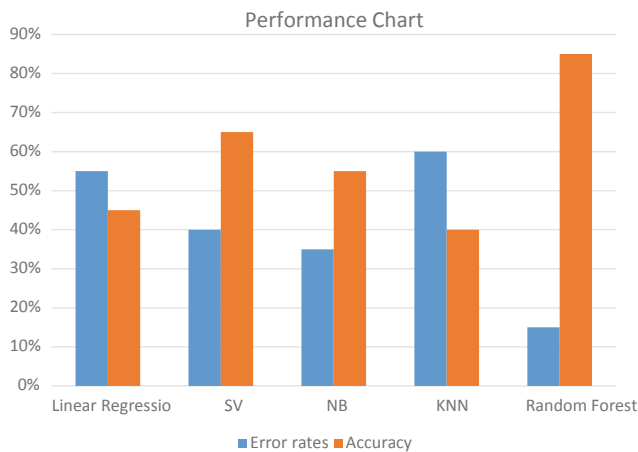
As shown in Fig. 3 and Table 1, the dataset used was fed into the system and the algorithms were applied as per our model, and the results were studied. The performance was calculated using the estimated confusion matrix and studied. The results were very promising, and the accuracy levels were compared from which it was inferred that the random forest was performed best with the accuracy of 95% which

**Table 1** Performance evaluation on the e-learning exam dataset

S. No.	Algorithm used	Error rates (%)	Accuracy (%)
1	Linear regression	43	65
2	SVM	30	78
3	NB	35	75
4	KNN	50	60
5	Random forest	20	95

**Table 2** Performance evaluation on the Legacy exam dataset

S. No.	Algorithm used	Error rates	Accuracy
1	Linear regression	55	45
2	SVM	40	65
3	NB	35	55
4	KNN	60	40
5	Random forest	15	85



**Fig. 2** Performance chart



**Fig. 3** Performance chart

was way better than the legacy systems of 85%. Thus, these results were utilized to conclude that the learning tools usages and benefits in these era of the Covid'-19 situation and the normal one.

### 4.2 Legacy Systems

See Fig. 3 and Table 2.

## 5 Conclusion

This research deals with the latest analytics methods in e-learning and also discusses the data mining-related various methods, techniques, algorithms including prediction and discovery related to the models based on the curriculum development behavior of learners and the student learning outcomes.

This research work also deals with the instructor performance improvement-related data tracking activities as well as the issues related to the teaching and learning. It also discusses lake of connections between learner and the instructor to improve the teaching learning process.

## 6 Future Work

The future work would be based on the learning engagement with the latest tools of the modern era, and their impact on the learners and the trainers/educators can be studied, and various studies can be performed and results can be measured and studied. If possible some new suggestions and improvements can be proposed in order to improve upon the teaching learning activities so that it can be further enhanced.

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