

**STUDENT ADAPTABILITY LEVEL PREDICTION IN ONLINE EDUCATION
DURING COVID-19 USING MACHINE LEARNING TECHNIQUES**

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This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

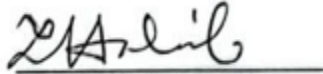
This Project titled **Students Adaptability Level Prediction in Online education during COVID-19 using machine learning approaches in Bangladesh.** submitted by **Mst. Sonia** and **Muhammad Osiur Rahman Mozu** to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 5-1-2023.

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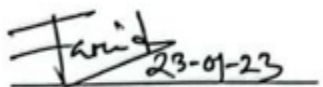
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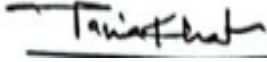
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DECLARATION

We hereby declare that, this project has been done by us under the supervision of Tania Khatun, Assistant Professor, Department of CSE, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

Distance learning (DL) is a method of instruction that makes use of technological advancements to allow for indirect connections between students and teachers who are separated by physical distance. Since COVID-19 swept the globe, the term "online education" has gained popularity. Most schools have moved their operations online so that instruction may continue even while they expand. It took a long time for a country like Bangladesh to guarantee online education at all educational levels. Our real objective is to contribute to this discussion by researching important aspects of online education. In this research, we conducted physical and online questionnaires to gather data from students at all three academic levels (school, college, and university) and also from Kaggle. The sociodemographic characteristics of a person are included in the survey form. A total of 14 variables were used: student gender, student type, age range, educational level of an institution, type of educational institution, IT student, student location, load shading level, family financial situation, category of internet, used device type, network connection type, and adaptability level of the learner. Our dataset was used to predict the level of student adaptability to online education using several machine learning algorithms, including Random Forest Classifier (RF), Decision Tree Classifier (DT), K-Nearest Neighbor (KNN), Logistic Regression (LR), Support Vector Classifier (SVC), and XGBoost Algorithm (XGB). The decision tree classifier surpassed other algorithms and had the highest accuracy (93%), compared to those that were used.

TABLE OF CONTENTS

CONTENTS	PAGE
Board of examiners	i
Declaration	ii
Acknowledgements	iii
Abstract	iv
CHAPTER	
CHAPTER 1: INTRODUCTION	1-4
1.1 Introduction	1
1.2 Motivation	2
1.3 Rationale of the Study	2
1.4 Research Questions	3
1.5 Expected Output	3
1.6 Project Management and Finance	4
1.7 Report Layout	4
CHAPTER 2: BACKGROUND	5-9
2.1 Preliminaries/Terminologies	5
2.2 Related Works	5
2.3 Comparative Analysis and Summary	8
2.4 Scope of the Problem	8
2.5 Challenges	9
Chapter 3: RESEARCH METHODOLOGY	10-19
3.1 Research Subject and Instrumentation	10
3.2 Data Collection Procedure/Dataset Utilized	10

3.3 Statistical Analysis	13
3.4 Proposed Methodology/Applied Mechanism	15
3.5 Implementation Requirements	19
CHAPTER 4: EXPERIMENTAL RESULTS AND DISCUSSION	20-25
4.1 Performance Evolution	20
4.2 Experimental Results & Analysis	21
4.3 Discussion	25
CHAPTER 5: IMPACT ON SOCIETY, ENVIRONMENT, AND SUSTAINABILITY	26-27
5.1 Impact on Society	26
5.2 Impact on Environment	26
5.3 Ethical Aspects	27
5.4 Sustainability Plan	27
CHAPTER 6: SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE	28-29
6.1 Summary of the Study	28
6.2 Conclusions	29
6.3 Implications for Further Study	29
REFERENCES	30-32

LIST OF FIGURES

FIGURES	PAGE NO
Fig. 3.3.1: The pie chart shows how different educational levels can adapt.	13
Fig.3.3.2: Age-based adaptation in a bar chart	14
Fig. 3.4.1: Predicting online learners' adaptation requires a systematic approach.	17
Fig. 3.4.2: Procedure framework	18
Fig. 4.2.1: Model classifiers	24

LIST OF TABLE

TABLE	PAGE NO
Table 3.2. 1: Details of the attributes and their probable values	12
Table 4.2.1: The Applied Models' Accuracy, Precision, Recall, and F1-Score	22
Table 4.2.2: It's a Matrix of Confusion Made by Applied Models	25

CHAPTER 1

Introduction

Distance learning (DL) is dislodging the "brick and mortar" classroom as the dominant learning setting. The COVID-19 pandemic has utterly destroyed the educational sector. All on-campus classes and activities have been canceled and moved to online venues as a result. Online learning reclaims the highest uses of the internet by using technology to build educational resources, offer to teach, and manage programs successfully and efficiently.

1.1 Introduction

On March 17 2020, Bangladesh ordered the closure of all of its educational institutions. To get an education in the digital realm, students bypass traditional classrooms in favor of their own personal computers, notebooks, or mobile devices. A recoverable loss for late-stage economies in a slow-growth phase is a prolonged period of time during which school is not in session. Both small and large organizations are being led to progress by exploiting the advancement of technology. But that all changed after an unplanned shutdown in March 2020. To that end, this research was conducted to survey the current state of online education in Bangladesh. If and when schools begin offering courses online, they also face many problems. Students in Bangladesh are familiar with taking traditional physical education lessons. In the COVID-19 situation, it is clear that online education is the best option for students to continue their education during that time. The effectiveness of online education must be known to educational institution decision-makers so that they can take additional measures to improve it for the students. We conducted an extensive survey to gather information from various universities, assess the perception of the student experience, and find out about students' experiences with online learning. From Bangladesh's vantage point, this study aimed to explore the gap between traditional classroom teaching and online courses. A study's objective is a single sentence that specifies what needs to be learned from all the different factors being studied. In studies without a hypothesis, research objectives can serve as a statement of purpose or be linked

to the hypothesis. The objective focus of research typically centers on how to measure the variable, such as by naming or describing it.

1.2 Motivation

Motivation for our projects below

- In online education, the learning level of the students and their interests are analyzed.
- Allows for the acquisition of new educational systems and student adaptation.
- It also demonstrates the importance of physical education as an alternative to keeping education active later in life.
- Opportunity to learn new educational platforms

1.3 Rationale of the Study

Our research objectives are as follows:

- To measure the adaptability level of learners in online classes.
- To understand the factors that hinder student participation in online classes.
- It will help the decision-makers make decisions in the field of making an online learning platform.
- Highlight different online tools and platforms used by educational institutions during the pandemic

1.4 Research Questions

- We hoped to find out more about the following through our investigation:
- In the future, will Bangladesh accept online education systems in place of physical education?
- The degree of adaptability is one factor used to gauge how well students can learn using online platforms.
- Are students getting the necessary facilities to adapt to online education?
- Can students learn a little in online education?

1.5 Expected Output

Through this research, the following things are known:

- To get an idea about the appropriate internet speed and network connection of the students who stayed outside the city and whether these factors interfere with the student's adaptation to online classes.
- A student's family economic status and educational institution type can have a big impact on good online class participation.
- This research can reveal the age range, educational institution level, and adaptability of a student's online class participation. Therefore, assessing adaptability based on these factors would highlight the weaknesses of online learning and identify the factors that have created unfavorable conditions for learners' participation and learning in online classes. which in turn can play an appropriate role in the decision-making and problem-solving of the decision-makers.

The entire work is done by following several steps.

First, data is collected from school, college, and university students. In the second step, the data is processed, and null and invalid data are eliminated. In the third step, the model is implemented, and a total of six types of algorithms are used to measure student adaptability levels.

1.6 Project Management and Finance

If funding is provided, we will do more detailed research on Bangladesh's online education system in the future. We have conducted this online-based research under our management and approval. Through this research based on machine learning, a detailed study has been done about the online education systems in Bangladesh.

1.7 Report Layout

This research study consists of five parts. The sections include an overview, a proposal, a literature review, research, a discussion of the findings, a final section, and a look ahead.

Chapter One: Introduction, Objective, Motivation, Expected Outcome, Report Layout

Chapter two: Literature Review, Preliminaries, Related Works, Comparative Analysis and Summary, Scope of the Problem, Challenges

Chapter Three: Proposed Research; Research Methodology, Data Collection, Data Processing, Flow Model, Experimental Layout

Chapter four: Results and Discussion; Experimental Result, Discussion.

Chapter Five: Conclusion and Future; Conclusion; Future Scope

CHAPTER 2

Literature Review

The current circumstance highlights the relevance of the online education system. Because of recent developments in technology, we are now able to establish digital classroom environments. In order to cope with these changes, students must rise to the challenge of adapting to online education. In what follows, we synthesize what we've learned from reading other articles on the topic of online schooling.

2.1 Preliminaries

As a result of the worldwide epidemic, most students have had to access their courses remotely. There have been many scholarly publications published concerning online learning from the beginning of the epidemic. Even though distance learning has many advantages for learning, it also has many disadvantages, such as weak technical science experiments, inconsistent synchronization, exam-related problems, and weak technical infrastructure.

2.2 Related Works

According to the authors in [1], undergraduate students were more receptive to web-facilitated and hybrid learning modalities than to online learning, as shown by their grades and assignment completion rates. According to the researchers [2], coping and self-regulation models should give adaptability much more weight. Based on their findings, the authors believe it could be useful for institutions engaged in the development, distribution, or management of online courses to examine methods to boost their students' academic outcomes [3]. According to Holliman, A., Martin, A.J., and Collie [4], Independent of age, gender, and prior achievement, the data reveal that flexibility has large direct influence on both positive and negative learning outcomes. According to [5], the study's findings that the participants had a high level of resilience may help to improve the perception of pandemic-inspired online learning, which has been plagued by many obstacles and challenges. Researchers [6] identified the variables that enable students to adapt to the module challenges and move forward with their studies; this study concentrated on the opinions of students studying our gateway level 1 program. The researchers' paper [7]

shows that how well students fit into classroom and online learning contexts influences their attitudes toward various forms of education. Researchers [8] focused on how the lack of face-to-face connection with professors and peers makes online learning more tiresome and monotonous, which causes dissatisfaction and stress. Researchers [9] identified this study as showing that students' resilience was low during the pandemic, and the findings indicated that measures to increase resilience should be taken into consideration.

Researchers [10] show that, according to the research authors, students should be encouraged to develop their academic resilience to help them better manage stress linked to their studies and boost their satisfaction with online learning. The researchers of [11] indicate that their analysis could aid in the thorough understanding of the current e-learning system and the degree of student learning adaptability by decision-makers in the education sector. Researchers [12] emphasized organizations that ought to actively look into ways to enhance students' well-being during the COVID-19 pandemic, including the reach, prominence, and scope of available support services. The authors [13] did research. Results indicated that flexibility does contribute significantly to this process. To provide insightful information about students' psychological conditions at a crucial juncture, researchers [14] develop flexibility as a personal resource in students' research, which is unquestionably valuable in and of itself. However, future research must focus on any effects related to pandemics and provide solutions for their management.

Researchers [15] found that the use of adaptive technology in education places an even greater focus on the duties of teachers. The authors [16] of the study found that for students to fully benefit from this new method of learning, preparation is essential for efficient online learning. In [17] this research, people use the term "techniques" to describe those utilized in conjunction with educational management and discussed, like polling students or requesting their opinion. According to the authors [18], the epidemic presents a challenge for educational institutions because it makes the detrimental effects of Romanian education's problems with the development of technology more apparent to students, parents, and teachers. The study by the authors [19] demonstrated the importance of social interaction. The study by the authors [20] shows that this particular factor is the least significant. This poll, found in [21], sheds light on how students at all educational levels in

Bangladesh feel about online education. Researchers [22] identified students' adaptability to situational affordances and constraints in the classroom.

According to the authors [25], teachers can significantly improve student performance by educating students about the significant contribution these constructs make to academic effectiveness. Researchers [23] were to investigate the extent to which university students' adaptability predicts their degree completion through behavioral engagement. The authors [24] demonstrate that students' ability to adapt to the working world increases with their level of intellectual humility. Researchers [23] were to investigate the extent to which university students' adaptability predicts their degree completion through behavioral engagement. The authors [24] demonstrate that students' ability to adapt to the working world increases with their level of intellectual humility.

According to the authors [25], teachers can significantly improve student performance by educating students about the significant contribution these constructs make to educational effectiveness. Authors [26] created *The Psychology of Working*. Authors [27] This survey emphasized the beneficial relationship and logical sequence of career adaptability resources and adapting reactions. According to [28], the proposed model accounted for 55% of the variation in career adaptability. Researchers [29] concluded that career adaptability is best described as a sequence instead of one factor. The authors of the paper's [30] findings Career adaptability is a distinct, multifaceted construct made up of five parts.

2.3 Comparative Analysis and Summary

Independent of factors like age, gender, and prior achievement, adaptability has a sizeable direct effect on both positive and negative learning outcomes. The participants' high level of resilience, as reported in [5], may contribute to a more positive impression of pandemic-inspired online education. Dissatisfaction and stress are the results of the monotony and weariness of online learning, which is made possible by the absence of face-to-face connection with professors and peers.

Researchers [15] found that the use of adaptive technology in education places an even greater focus on the duties of teachers. For students to fully benefit from this new method of learning, preparation is essential for efficient online learning. Researchers [22] identified students' adaptability to situational affordances and constraints in the classroom. According to the authors [25], teachers can significantly improve student performance by educating students about these constructs.

2.4 Scope of the Problem

The following is a list of issues that students have to deal with:

- The load-shedding issue interferes with the student's ability to participate and pay attention in class.
- We had to use expensive mobile data and Wi-Fi in this situation.
- A large number of students attended the class but were unable to fully understand the material due to the slow network speed.
- Many people, including those who enrolled in online courses, had a difficult time adjusting to the new platform.

2.5 Challenges

- It is true that not everyone in Bangladesh has access to online education.
- Students struggle in this pandemic because of poor learning materials, unsuitable learning attitudes, low classroom participation, an inadequate home environment, and a lack of self-discipline.
- Many students are unable to participate in online courses because they do not have access to a smartphone, computer, or laptop.
- Teachers and students in remote highland villages, chars, horas, and villages lack virtual education information and training.
- Outside of the city, 3G/4G networks and broadband services are not widely accessible. As a result, those who have a subpar 2G network will be unable to regularly attend classes.
- Students lose interest in online classes because they are unable to see or hear the teacher clearly while listening to a sermon due to a lack of electricity and a shoddy network.
- Currently, a major problem is the lack of software for taking practical classes.
- In addition, there are issues with making sure that students take exams online and that a comprehensive assessment is conducted.

CHAPTER 3

Research Methodology

The current circumstance highlights the significance of the online education system. Because of recent developments in technology, we are now able to establish digital classroom environments. In order to cope with these changes, students must rise to the challenge of adapting to online education. In what follows, we synthesize what we've learned from reading other articles on the topic of online schooling.

3.1 Research Subject and Instrumentation

Our main topic in this research is to measure the adaptability level of students participating in online classes through a machine learning approach. Here various methods, algorithms, and matrices are used using the Python programming language. We have completed our entire coding work on the Kaggle platform. What was needed for this research was data, which we gathered from students by filling out an online form and some from Kaggle data. This section's goal is to describe our research strategy. Three sections are present: data collection, data possession, and model descriptions.

3.2 Data Collection Procedure

conducted an extensive survey to collect data by evaluating the opinions of students from different universities. 1500 data points were collected from various students. A small portion of this data was obtained from Kaggle, where the differences and acceptability between online and offline classes are explored. We gathered the information. The pupils were asked to respond to the following questions: There were a total of 14 factors considered, including student gender, student type, age range, educational level, educational institution, IT student, student location, load shedding level, family financial situation, internet type, used device type, network connection type, and learner adaptability. The data gathered from these surveys is used to determine the limits of what can be taught via distance education.

We started by manually translating the original Bengali dataset into English to aid in subsequent processing. We then changed the string attribute values to numeric values, making them more digestible and usable by models. This process included encoding the nominal attributes into numerical values and normalizing the continuous attributes. To do this, we used an encoding technique called label encoding, which assigns a unique number to each string. Low, medium, and high adaptation levels are denoted by 0, 1, and 2, respectively. Table I provides a detailed list of the 14 features we used, along with the class values we assigned to them during the data preprocessing stage.

Figure 1 shows our dataset visually, along with pie and bar charts (Figures 2–3). Gender, type of student, age, grade, educational institution level, type of institution, IT students or not, location, load-shedding level, financial situation of their families, internet type, type of network connection, and educational level all play significant roles in determining their level of adaptability. Through data visualization in bar charts and pie charts, it is possible to demonstrate the role that these subjects play in students' capacity for adaptation.

Table 3.2. 1: Details of the attributes and their probable values

Variable Name	Full-From	Variable Type	Problem Value
GT	Gender Type	Independent	Girl(0), Boy (1)
ARTS	Age range of the student	Independent	Around 1 to 5 (0), 6 to 10 (1), 11 to 15 (2), 21 to 25 (4), 26 to 30 (5), 30+(6)
EIL	Education Institution Level	Independent	School (0), College (1), University (2)
EIT	Education Institution Level Type	Independent	Non Government Ins (0), Government Ins (1)
SITS	Studying as IT Student	Independent	No (0), Yes (1)
ISLT	Is student location in town	Independent	No (0), Yes (1)
LLS	Level of Load shedding	Independent	Low (0), High (1)
FCF	Financial Condition of Family	Independent	Poor (0), Mid (1), Rich (2)
ITUMD	Internet type used mostly in device	Independent	2G (0), 3G (1), 4G (2)
DUMC	Device used mostly in class	Independent	Tab (0), Mobile (1), Computer (2)
NCT	Network connectivity type	Independent	Mobile Data (0), Wi-Fi (1)
DCD	Daily class duration	Independent	0 (0), 1 to 3 Hours (1), 3 to 6 Hours (2)
IOLA	Institution's own LMS availability.	Independent	No (0), Yes (1)
ALTS	Adaptability level of the student	Dependent	Low (0), Moderate (1), High (2)

3.3 Statistical Analysis



Fig. 3.3.1: The pie chart shows how different educational levels can adapt.

The pie chart indicates that their capacity for adaptation was average. 51.4% of students moderately accepted online courses. The rate of adaptively of 40.1% of students was low. And the lowest was 8.47% for high adaptively. Moreover, we can get more information from other pie charts. 52.2% of students were male. More students from non-government schools took online courses as well, and 77.4% of these students were from urban areas. As a result, the load-shedding rate during online classes was very low at 16.5%. The majority of these students came from middle-class families. Internet usage for students using mobile data was 57.6%. The maximum class period was one to three hours, and 84.2% of the students used their mobile devices to participate.



Fig.3.3.2: Age-based adaptation in a bar chart

Variable research, as evidenced by the graphs as a result, gender is balanced by applying it to an equal number of men and women. The majority of the topics fall within the age range of 11 to 25 years, which is the point at which we can reliably discuss long-term learning adaptation. The degree of education suggests that the majority of the subjects have only completed their secondary education. The majority of the individuals in these data are between the ages of 7 and 20, and existing educational services are offered by non-private institutions.

The growth of the education market is to blame for this. It needs to be highlighted that the majority of advertising is offered on phones using the 4G network, demonstrating that individuals can receive education wherever it is most convenient for them. It should be mentioned that some students need to retain information from online courses. Men are more easily able to learn new information, and men and women both have roughly the same levels of poor adaptability. The strongest adaptation is shown between the ages of 21 and 25, and between 11 and 15, whereas the worst is seen between the ages of 26 and 16, and 20. social and physiological

Aspects can be used to explain why people have poorer adaptability to new information. It should be highlighted as well that the middle class is where the material is most easily assimilated. This phenomenon is one that we could discuss for a very long time. Urban dwellers exhibit high adaptation to the material, which can be attributed to social and economic circumstances. The quality of the Internet also affects how well people adjust to new information.

3.4 Proposed Methodology

It is possible to predict students' levels of adaptability using any number of ML methods. A wide range of ML techniques were employed in the training and assessment of our dataset. Random Forest Classifier (RF), Decision Tree Classifier (DT), K-Nearest Neighbor (KNN), Logistic Regression (LR), Support Vector Classifier (SVC), and XGBoost Algorithm (XGB) are only some of the tools used to make forecasts and analyses.

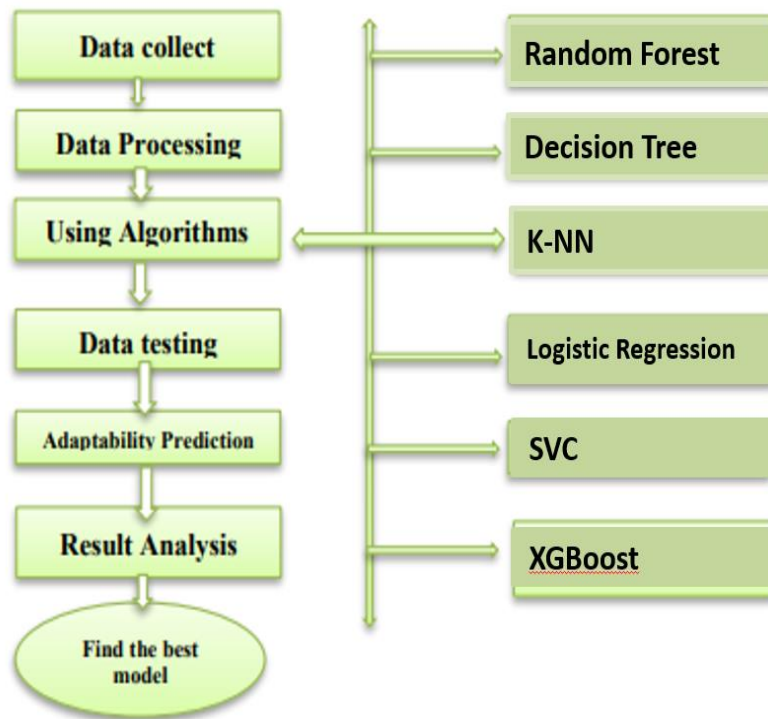


Fig. 3.4.1: Predicting online learners' adaptation requires a systematic approach.

Random Forest: We found that by pooling the results of multiple machine learning algorithms, we could produce forecasts with greater precision than any individual model. In order to find the best solution, the Random Forest algorithm uses a voting system after constructing decision trees from data samples and obtaining predictions from each tree.

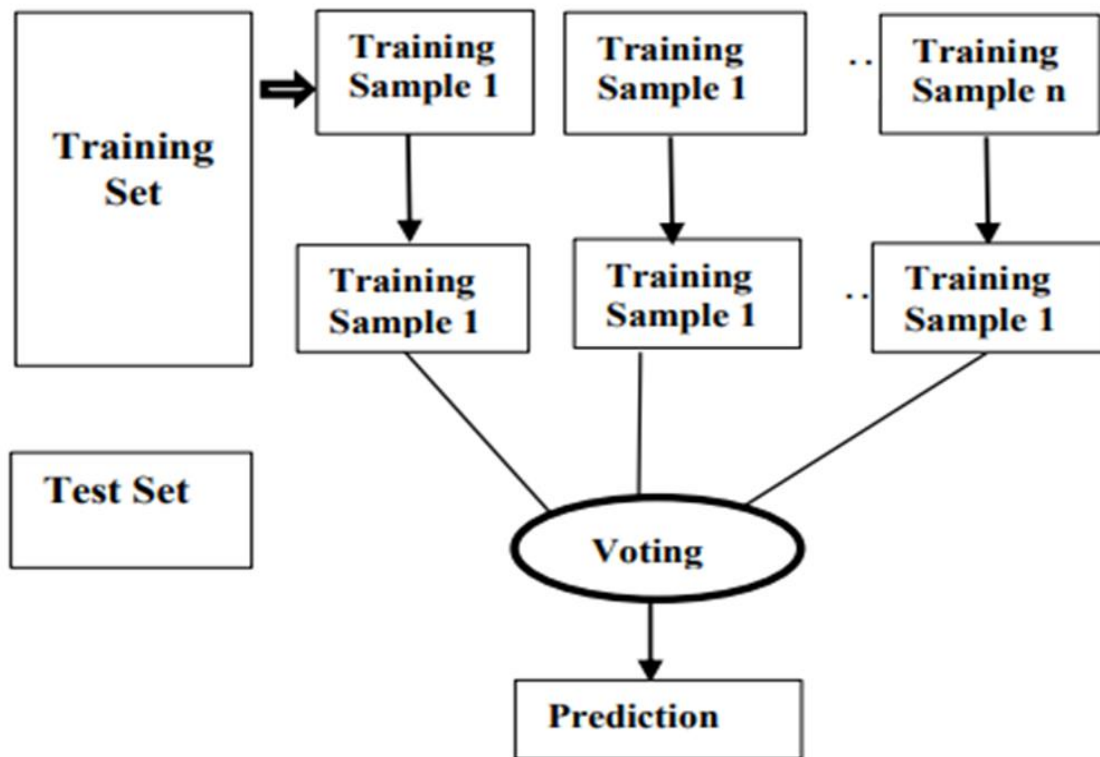


Fig. 3.4.2: Procedure framework

The function of the margin that is used for RFC is

$$\vec{r}(X, D_n) = E_{\theta}[r_n(X, \theta, D_n)]$$

Decision Tree: For supervised learning, the decision tree is the most well-known and effective technique. To make decisions or solve problems involving decisions, this algorithm is invaluable. By answering yes/no questions, one can work through the tree from a single data point. In this case, Each leaf node's mean value of the dependent variable serves as the final forecast. . One of the simplest machine learning techniques is called K-Nearest Neighbor (KNN). One reason for the KNN success is because it is so straightforward to use. fast understanding and speedy computation. KNN constructs its categorizations by comparing a new data point to the points in its vicinity. Then, it employs that distance function to place itself in the group with the k neighbors who share the most characteristics with it.

K-Nearest Neighbors:

The following is the primary idea underlying k-nearest neighbors. We can try to figure out which points in our feature space are closest to a point whose class we don't know. These are the k-closest neighbors. Because comparable entities occupy similar locations in feature space, the point is extremely likely to belong to the same class as its neighbors. Based on this, a new point may be classified as belonging to one of two classes.

In order to calculate the distance vector, we use the following formula:

$$d(p, q) = \sqrt{\sum_{i=0}^n (q_i - p_i)^2}$$

where q_n stands for the attribute values of one observation and p_n stands for the attribute values of another observation.

Logistic Regression: A logistic regression model is an analytical tool that aids in estimating the likelihood that an event will occur. It can be used to predict events with a binary result, such as whether or not someone will pass their driving exam. In this article, we examine the definition, methodology, and forecasting applications of logistic regression.

Support Vector: Support When it comes to solving classification problems, the Vector Classifier is a well-liked supervised machine learning strategy. By projecting the data points into a high-dimensional space and then finding the optimum hyperplane, SVC may classify the data into two distinct groups.

XGBoost: In order to more precisely forecast a target variable, the supervised learning process known as "gradient boosting" combines the predictions of multiple less complex models. Regression trees are the weak learners in regression gradient boosting because each input data point is assigned to a leaf with a continuous score. With a convex loss function (based on the difference between the anticipated and target outputs) and a penalty term for model complexity, XGBoost seeks to minimize a regularized (L1 and L2) objective function (in other words, the regression tree functions). A forest of trees capable of predicting future residuals and mistakes is grown through training iterations.

3.5 Implementation Requirements

There are some important steps that are required to implement the whole process.

- Importing the required data and libraries
- Conduct a data analysis that is exploratory.
- Keep the data type in mind.
- Look for any informational gaps in the table.
- You should examine the dataset's statistics.
- Creating a general distribution of features based on their number as part of data analysis.
- Distribution of students' numbers according to their level of adaptation
- Move on to artificial intelligence. Ordinal Encoder variable encoding
- Divide data and construct pipelines, then apply artificial duplication because the classes are out of balance.
- Use a matrix and algorithms.

CHAPTER 4

Experimental Results and Discussion

The outcomes of each classifier are described in this section. This part is split into two subsections: the Applied Model Performance Evaluation and Analysis. This section contains detailed descriptions and analyses.

4.1 Performance Evaluation

There are a number of indicators that may be used to gauge an ML model's efficacy. Accuracy, precision, recall, and F1 score are the most weighted metrics when assessing a model's efficacy. During model testing, the confusion matrix is generated, and its value is used to calculate precision, recall, and F1. These figures were determined using the formulas in Score and Precision Equations 1, 2, 3, and 4.

$$\text{Precision} = \frac{TP}{TP+FP} \dots\dots\dots(1)$$

$$\text{Recall} = \frac{TP}{TP+FN} \dots\dots\dots (2)$$

$$\text{Accuracy} = \frac{TP+TN}{TP+FP+FN+TN} \dots\dots\dots(3)$$

$$\text{F1-Score} = \frac{2*\text{Precision}*\text{Recall}}{\text{Precision}+\text{Recall}} \dots\dots\dots (4)$$

TP stands for "true positive," whereas TN for "true negative." FP and FN stand for "false positive" and "false negative," respectively. We measured the model's efficacy using four metrics: precision, recall, accuracy, and F1 Score.

4.2 Experimental Results & Analysis

Table II shows the F1-score, accuracy, precision, and recall of the different models. The decision tree classifier had the best accuracy rate (93%) out of the six machine learning forecasting models we used; whereas logistic regression had the lowest (64%) rate of success. Class-wise accuracy scores of 0.92, 0.94, and 0.94 for the low, moderate, and high adoption categories, respectively, were also obtained using the decision tree model. The class-wise recall has also been calculated here. The lowest adaptability category was scored at 0.99 for the methods decision tree, Random Forest, K-Nearest Neighbor (KNN), and XGBoost.

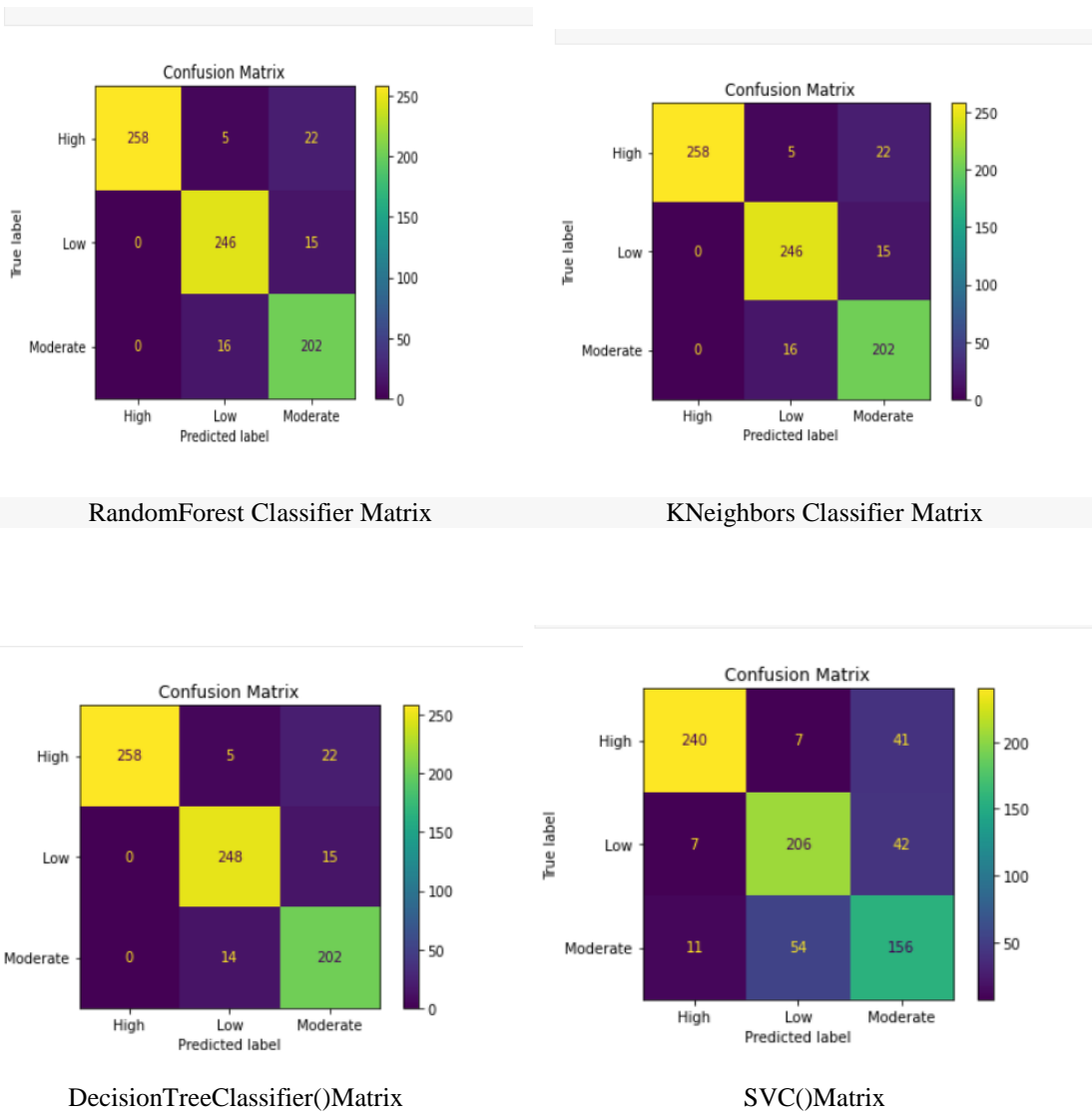
High adaptability was scored at 0.86, and moderate adaptability at 0.94, both of which were achieved by the decision tree. When testing a model under realistic conditions, where inequalities in class distribution are the norm, the F1-score provides a more accurate evaluation. The higher the F1 numbers, the better the models are doing.

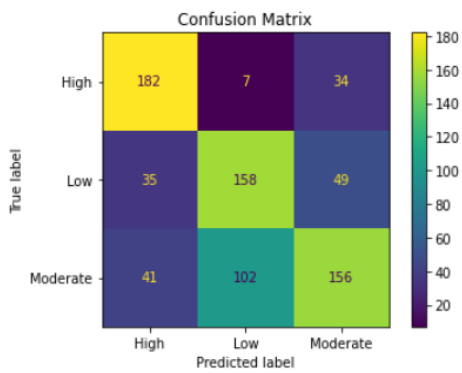
Table 4.2.1: The Applied Models' Accuracy, Precision, Recall, and F1-Score

Model	Class Name	Accuracy	Precision	Recall	F1 Score
RF	Low adaptability	92%	0.91	0.99	0.95
	Moderate adaptability		0.94	0.92	0.93
	High adaptability		0.91	0.84	0.87
DT	Low adaptability	93%	0.92	0.99	0.95
	Moderate adaptability		0.94	0.94	0.94
	High adaptability		0.94	0.86	0.90
KNN	Low adaptability	88%	0.88	0.99	0.93
	Moderate adaptability		0.89	0.88	0.88
	High adaptability		0.88	0.77	0.82
LR	Low adaptability	64%	0.80	0.70	0.75
	Moderate adaptability		0.63	0.57	0.60
	High adaptability		0.54	0.67	0.59
SVC	Low adaptability	79%	0.82	0.93	0.87
	Moderate adaptability		0.85	0.75	0.80
	High adaptability		0.69	0.69	0.69
XGB	Low adaptability	92%	0.91	0.99	0.95
	Moderate adaptability		0.94	0.92	0.93
	High adaptability		0.91	0.84	0.87

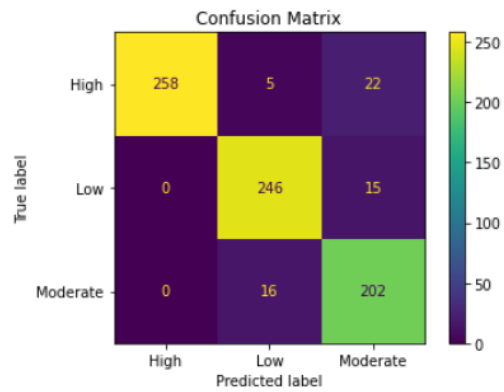
Table 2 shows that DecisionTree has the greatest F1-score across all three categories of adaptation (low, moderate, and high): 0.95, 0.94, and 0.90, respectively. According to the study of the results discussed above, the DecisionTree model outperformed the other models in terms of performance measures. It can be seen from the micro-average that the DecisionTree model produces high-quality results. Therefore, the DecisionTree model may be a useful option for predicting students' adaptation to online learning.

The following code is used to extract the matrix of all algorithms used.





LogisticRegression()Matrix



XGBClassifier()Matrix

Fig. 4.2.1: Model classifiers

The results of the students' adaptability were predicted using a variety of methods, including: classifier, decision tree classifier, K-Nearest Neighbor (KNN), logistic regression, support vector classifier, and XGBoost Algorithm. The objective was to improve the predicted accuracy of the model by comparing the results from several models. The remaining 70% was used for training purposes, while the remaining 30% was used as a test set. Working with difficulties involving several classes (three in this case). The models used to evaluate the data resulted in the confusion matrix displayed in Table III.

Table 4.2.2: It's a Matrix of Confusion Made by Applied Models

	Model	Class Name	Predicted		
	Actual	RF	Low	Low	Moderate
High			246	15	6
Moderate			17	205	17
DT		Low	0	3	255
		High	247	14	6
		Moderate	15	205	19
KNN		Low	1	2	255
		High	247	14	6
		Moderate	15	205	19
LR		Low	1	2	255
		High	163	92	12
		Moderate	51	160	28
SVC		Low	40	32	186
		High	196	60	11
		Moderate	36	160	43
XGB		Low	9	13	236
		High	244	17	6
		Moderate	15	202	22

4.3 Discussion

After all the processes, we can conclude that the adaptability level among the students who participated in the online class was moderate. The algorithm that provides the highest accuracy among all the algorithms that we have used to reach this decision is the Decision Tree algorithm. which has a 93% accuracy rate. We confirmed its authenticity through matrix analysis.

CHAPTER 5

Impact on Society, Environment and Sustainability

5.1 Impact on Society

The pros and cons that affect society are covered in this article.

- Online education can be a significant alternative in the event of a brief disruption of the physical education system.
- Classes can be held at home, cutting down on wasted time.
- Students who reside outside of the city will be at a disadvantage because they lack the facilities required to take online courses.
- An internet connection is a requirement, which will cost money.
- Since students will be carrying devices, they will use them for a variety of pointless tasks.
- Since there won't be any direct communication, their friendly relationship may deteriorate.

5.2 Impact on the Environment

It will also affect the environment in other ways, such as:

- Educational institutions will be deserted.
- Those who are decision-makers will have an advantage in making decisions later.
- Teachers, students, and close girlfriends will not be friendly.
- Students will not be able to learn anything if they cannot properly adapt to the class. as a result, the education system will deteriorate.

5.3 Ethical Aspects

The system of online education also has some ethical considerations.

- Ensuring that students stay on track with their studies even when taking classes online
- Briefly explain the new educational system to the students

5.4 Sustainability Plan

Making an effort to create a long-term strategy for sustainability by means of this research.

We must look at a few things to keep this basic education system online:

- Keeping a reliable internet connection
- Having electronic devices in class that can be used for connectivity.
- Addressing the load-shedding issue.

CHAPTER 6

Summary, Conclusion, Recommendation, and Implication for Future Research

The data produced by this project provides a bird's-eye view of the search volume for a specified term. These results have applications in many fields, including academia, industry, and commerce. We're still tweaking it to improve the outcome and put it to better use in helping people. The real difficulty, however, lies in teaching and training future generations to use our ways.

6.1 Summary of the Study

Despite the COVID-19 outbreak, online education will continue in Bangladesh. In-person and online surveys were used to compile data on respondents' levels of schooling. Machine learning models were utilized to make the forecast. Several other methods were employed besides XGB, including Decision Tree, Random Forest, K-Nearest Neighbor (KNN), Logistic Regression, and SVC. Machine learning models did well enough at making predictions. Amongst the models tested, the decision tree demonstrated the highest predictive accuracy (93%). Our research shows that students in Bangladesh at all educational levels have favorable opinions about online learning. This study has the potential to inform policymakers about the efficacy of the current online education system and the extent to which students have adapted to it. As a result of working on this project, we grew as individuals and as a team and learnt how to effectively address and overcome several obstacles. Data mining and analysis are skills we honed during this assignment. In-house competence in real-time data analysis has been developed. Everybody enjoyed themselves while they were working on the project. Data collection was the main challenge we faced. That's why we needed so much time to gather information. Although it was a gradual process, we learned from the pupils. We used a Google form to learn about students' adaptation levels for our analysis. We also received suggestions on how to enhance the online education system in unusual circumstances.

6.2 Conclusion

In order to foresee how effectively Bangladeshi students would adapt to online education during the ongoing COVID-19 epidemic, we used machine learning in this study. According to our research, high school, college, and university students in Bangladesh have a general attitude toward online learning. This study could aid in the thorough understanding of the current online education system by decision-makers in the education sector.

6.3 Implications for Further Study

This study may help policymakers understand the state of the online education system and the extent to which students have adapted to this mode of instruction. We plan to investigate the long-term effects of online learning on students' health and cognitive growth.

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