

**E-LEARNING EMERGENCE: A COMPREHENSIVE ANALYSIS OF ONLINE
EDUCATION'S EXPANSION AND PROSPECTS IN BANGLADESH**

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FINAL YEAR DESIGN PROJECT REPORT

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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DHAKA, BANGLADESH

JULY 2024

APPROVAL

This Project titled “**E-Learning Emergence: A Comprehensive Analysis of Online Education's Expansion and Prospects in Bangladesh**”, submitted by **Rubayed Ahmmad Rakin** 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 **14th July, 2024**.

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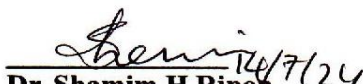
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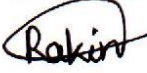
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ACKNOWLEDGEMENT

First, I express our heartiest thanks and gratefulness to almighty for His divine blessing making it possible for us to complete the final year project successfully.

I am grateful and wish our profound indebtedness to **Md. Aynul Hasan Nahid, Lecturer**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of “*E-Learning*” to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts, and correcting them at all stages have made it possible to complete this project.

I would like to express our heartiest gratitude to the **Head of the Department of CSE**, for his kind help in finishing our project and also to other faculty members and the staff of the Department of CSE, Daffodil International University.

I would like to thank our entire course mate in Daffodil International University, who took part in this discussion while completing the course work.

Finally, I must acknowledge with due respect the constant support and patience of our parents.

ABSTRACT

This study explores the growth of e-learning in Bangladesh, analyzing its socioeconomic, environmental, and sustainability implications using survey data. The analysis includes aspects like internet connectivity, device usage, study hours, course quality, efficacy, engagement, and affordability. This study applied seven machine learning classification models—Logistic Regression, Random Forest, K-Nearest Neighbors, Support Vector Machine, Gaussian Naïve Bayes, Decision Tree, and XGBoost. Random Forest notably outperformed with 78.22% accuracy in predicting the potential of online education to replace traditional methods. According to the findings, 98.8% of students had regular internet access, with 50% reporting extremely stable connections. 60.9% of respondents use smartphones as their primary device, highlighting the need for mobile-friendly learning systems. Approximately 50% of students spend less than five hours each week on online learning platforms such as YouTube and Zoom. 68% of students assess course quality positively, while 33.7% believe online classes are more effective than traditional methods. Despite these advantages, obstacles such as technological difficulties, a lack of desire, and feelings of isolation remain. To overcome these difficulties, the research advises increasing technical assistance, creating interesting material, and boosting teacher training. Furthermore, advancements in internet infrastructure and device accessibility are crucial to the sustained expansion of e-learning. The paper continues with recommendations for future research, emphasizing the importance of longitudinal studies to measure e-learning's long-term impact, as well as the potential benefits of hybrid learning models that blend online and traditional teaching approaches. All things considered, e-learning in Bangladesh has a lot of promise, but for it to grow sustainably, it must overcome current obstacles.

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LIST OF ACRONYMS

LR	Logistic Regression
NB	Naïve Bayes
SVM	Support Vector Machine
KNN	K-Nearest Neighbors
RF	Random Forest
DT	Decision Tree
XGB	Extreme Gradient Boosting
ROC	Receiver Operating Characteristic
ICT	Information and Communication Technology
BOU	Bangladesh Open University
UNESCO	United Nations Educational, Scientific and Cultural Organization
CO ₂	Carbon Dioxide

CHAPTER 1

INTRODUCTION

1.1 Overview

Bangladesh's educational scenery has undergone significant transformation in recent years as e-learning has gained popularity. New opportunities for learning beyond common face-to-face learning have been made credible by the progressive effect of advanced innovations on outlining instructive standards. This transition has been notably conspicuous in Bangladesh, where e-learning platforms, online courses, and virtual classrooms have flourished. Beyond socioeconomic and geographic restrictions, increased participation in online education has been made possible by the increasing usage of smartphones and the availability of reasonably priced internet connections.

According to WIKIVERSITY, E-learning is a learning environment that uses ICT as a platform for teaching and learning activities [1]. Encyclopedia describes online education as Online education is a flexible instructional delivery system that encompasses any kind of learning that takes place via the Internet [2].

Bangladesh Open University (BOU) was the first public sector university that introduced distance learning in 1992 [3]. In 2011, JAAGO Foundation, a non-profit organization, started the 'Digital School' project which was the first online school in the history of Bangladesh [4]. During the COVID-19 pandemic, the expansion of online education started in full swing which saved the country's education system from stalling.

1.2 Problem Statement

Bangladesh's traditional, in-person educational institutions are challenged by several issues, such as a lack of skilled educators, inflexible learning schedules, and restricted access to high-quality education in rural areas. For people from underprivileged origins or those wishing to explore chances for lifelong learning, these constraints may make it more difficult for them to complete their higher education.

1.3 Motivation and Objectives

This study is driven by the need to assess e-learning in Bangladesh observationally and to identify strategies for robust development. It focuses on examining the factors driving the growth of online education and breaks down significant barriers that demonstrate the potential advantages of e-learning to encourage inclusiveness, quality, and accessibility to education.

The principal goals consist of:

- To investigate the swift improvement of Online Education in Bangladesh
- To evaluate the effect of virtual learning on traditional education in Bangladesh
- To figure out the principal aspects influencing the adoption of E-Learning in Bangladesh
- To investigate e-learning hurdles and challenges in Bangladesh
- To anticipate prospects of online education in Bangladesh

1.4 Project Scope

The advancement of e-learning in Bangladesh is the primary area of this research. The impact of e-learning on various educational levels, from primary to higher education. This study also aims at how wide-ranging and accessible online learning is for people of different positions. It incorporates stakeholders such as teachers, students, policymakers, e-learning associations, and online learning resources like virtual classrooms, online courses, skill advancement, etc. Also, the financial facts that block virtual learning availability, educational equity, and the role of government policies and regulations in promoting e-learning are the subjects of this exploration.

1.5 Project Outcome

This research seeks to provide insightful information about e-learning in Bangladesh considering the existing circumstances that will help to find out prospects of online education. This study aims to serve a broad understanding of the benefits and drawbacks of online learning for changing several aspects, including investment and educational strategies, policymaking, etc.

1.6 Report Organization

This research paper will be organized as follows:

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Methodology/ Requirement Analysis & Design Specification

Chapter 4: Implementation

Chapter 5: Result and Analysis

Chapter 6: Impact on Society, Environment and Sustainability

Chapter 7: Conclusion and Future Work

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1.7 Summary

This research project aims to provide a comprehensive analysis of e-learning's emergence and prospects in Bangladesh. It hopes to contribute to the advancement of a more inclusive, accessible, and effective educational system for all Bangladeshis by exploring its present status, and potential to address existing challenges and unlock new opportunities.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

The introduction segment on e-learning in Bangladesh gives details on the factors impacting the improvement of online learning in the country. It additionally checks out the benefits and barriers of online education. This part plans to give a wide comprehension of e-learning's present status in Bangladesh, as well as its true capacity going ahead and the useful open doors it brings. This will be accomplished by integrating significant outcomes from prior research regarding this matter.

2.2 Related Works

S. H. B. Shahriar et al. [5] reviewed a tentative analysis from Bangladesh's perspective that looked at the potential and impact of web-based training and e-learning for employees to enhance their skills during a pandemic, particularly the COVID-19 crisis. Detailed interviews were held as part of the data collection process, complemented by probing inquiries to delve deeper into their responses and the primary topic. Qualitative methodologies were employed to analyze and explore the data, which was divided into two clusters: responses from employees and the HR department. Their study, which focused on task completion and adaptation to new changes in online employee training, indicates that Bangladesh has the potential to become a key e-learning hub. The employed algorithm was not mentioned in their paper.

F. T. Proggia et al. [6] shed light on the attitudes of Bangladeshi university students regarding the efficacy and challenges of online learning in the context of the COVID-19 pandemic. The study involved the invigilation of 55 students, with 72 and 18 percent of male and female students, respectively. Student performance in comparison to the previous semester and student feedback on the circumstances comprise the two areas of findings from the switch to online instruction in Google Classroom. With 60-70% of the semester completed before the pandemic, only 6% received a score below 60, 35% between 60 and 70, 35% between 70 and 80, 28% between 80 and 90, and 19% higher than 90. This study depicts certain challenges such as Internet connectivity, power outages, and the adverse effects of the pandemic, while also incorporating 36.4% of positive responses from the students. They did not identify the algorithm that was used in their research.

M. K. B. Chowdhury et al. [7] suggested hybrid education as a workable solution for pursuing higher education to help students who struggle to balance their time between work and study. To analyze issues with adopting online higher education and the potential for

blended learning in Bangladesh, they look through earlier publications such as newspaper and journal articles, PhD thesis papers, conference papers, and websites. They identified several issues, including the nation's digital divide, the expense of technology, and negative perceptions held by parents, teachers, and students toward online learning. Private institutions acted quickly in shifting to online education, but public universities trailed behind. Pay no heed to these issues, blended learning could assist in removing some barriers, such as the lack of seats, session jams, and traffic jams in large cities, reducing costs and dropout rates by combining education with employment, and so on. They did not specify the algorithm used in their study.

L. Sarkar [8] paid attention to the advantages of online learning over traditional physical education for elementary school students and the efficacy of technology in Bangladesh. The only area of study covered by this research is online English language teaching and learning. That's why they used two separate questionnaires to gather quantitative and qualitative feedback from 100 students as well as 10 English professors. They used a Likert scale to calculate the average score for quantitative data and provide appropriate charts for qualitative data. They received positive feedback from both teachers and students. The researcher was unable to contextualize his literature evaluation due to a limited number of prior studies conducted in Bangladesh's conditions.

M. Badiuzzaman et al. [9] investigated the digital divide that exists among students in online education during the COVID-19 pandemic and the reasons behind it. They applied the snowball method to collect qualitative and quantitative data from the students and found that 32.5% of students joined online classes without any issues, 34.1% thought that data costs were excessive and 39.8% of the students faced poor network connection. They introduced three levels of the gap — access, usage, and utility where expensive cost, network quality, spending the most time on social media, and less benefit from online as well as offline were the key themes behind the gaps. The study's sample size is projected to be limited due to the rigid lockdown situation.

M. S. Ullah et al. [10] found out the performance of the students on e-learning by surveying 214 undergraduate students in two phases and the administrative office. They applied partial least square structural equation modeling (PLS-SEM) for solving complicated structural equations and the SPSS v25 method to calculate descriptive statistics and inter-construct correlations. Based on their observations, the main drivers of students' responses to online classes were their motives and comfort. The study's shortcomings were the potential for national bias, data collection from only public universities' business schools, e-learning usage and post-use effects at a certain time, a focus solely on self-regulated learning, and only consideration of online class attendance and academic success.

K. Maisha et al. [11] explored the concept of ongoing implementation of online learning in the education sector after the pandemic period. After gathering data from university students and applying the UTAUT3 model as the theoretical basis, they conducted an analysis and discovered that, while many students continued the e-learning, the primary goal for the students was to improve their academic performance. However, their sample collection was biased.

2.3 Comparison between existing works

Table 2.3.1. Comparative analysis with previous work

SL No	Author Name	Used Algorithm	Best Accuracy with Algorithm
1.	Shahriar, S. H. B. et al. [5]	Not Specified	Not Specified
2.	Progga, F. T. et al. [6]	Not Specified	Not Specified
3.	Chowdhury, M. K. et al. [7]	Not Specified	Not Specified
4.	Sarkar, L. et al. [8]	Likert scale to measure the mean score for each statement.	Not Specified
5.	Badiuzzaman, M. et al. [9]	Microsoft Excel was used to analyze the quantitative data	Not Specified
6.	Ullah, M. S. et al. [10]	PLS-SEM, SPSS v25	Not Specified
7.	Maisha, K. et al. [11]	UTAUT3, SEM-PLS3.3.9, CB-SEM, Fornell–Larcker criterion, cross-loading	Not Specified

2.4 Gap Analysis

The extant literature on e-learning in Bangladesh highlights several significant inadequacies. First, questions concerning the validity and generalizability of results are raised by vague methods and a lack of clarity surrounding the algorithms employed in earlier research. Second, knowledge of Bangladesh's particular potential and problems needs to be improved because of a shortage of studies on the subject. Thirdly, concerns regarding the representativeness of study findings are raised by possible restrictions in sample sizes brought on by outside variables. Finally, a more thorough and inclusive strategy for researching e-learning in Bangladesh is required in light of the flaws that have been discovered, which include possible national bias, small sample sizes, and a restricted research emphasis.

2.5 Summary

The literature review provides a detailed summary of the extant research on e-learning in Bangladesh. The lack of algorithm identification and the restricted contextualization within local settings draw attention. Furthermore, it points out difficulties such as restricted focus areas, potential biases, and sample size limitations brought on by lockdowns. To gain a better grasp of e-learning dynamics in Bangladesh, methodological clarity, contextual sensitivity, and broader study scopes are required.

CHAPTER 3

METHODOLOGY/ REQUIREMENT ANALYSIS AND DESIGN SPECIFICATION

3.1 Overview

This research aims to investigate the growth and future potential of online education in Bangladesh. A mixed-methods strategy is used to accomplish this. This approach combines qualitative insights and quantitative data analysis, like statistical methods. By utilizing both approaches, the study strives to gain a comprehensive understanding of the multifaceted nature of e-learning implementation in the Bangladeshi context.

3.2 Data Collection

A structured Google Form survey was used to gather data, with 404 participants from a range of age groups, localities, and educational backgrounds, in order to undertake a thorough analysis of the growth and possibilities of e-learning in Bangladesh. The survey was divided into categories on demographic information, accessibility and usage, quality of online education, engagement and interaction, challenges and barriers, benefits and advantages, and future prospects. Demographic questions gathered important participant information, while accessibility and usage sections assessed the availability and usage trends of e-learning technologies. Participants' satisfaction with teaching effectiveness and resource adequacy were used to assess the quality of online education. Interaction and engagement questions investigated student involvement and teacher responsiveness. Challenges and barriers included technological issues and a lack of desire, whereas benefits and advantages emphasized flexibility and ease. Future prospects received feedback on prospective enhancements and the future usage of e-learning platforms. This survey generated a broad and thorough dataset by addressing a wide spectrum of respondents, which is crucial for examining the current state of e-learning in Bangladesh and estimating its future potential. This extensive data collection technique serves as a solid platform for future analysis and strategic recommendations.

3.3 Proposed Methodology/System Design

The proposed technique comprises many important phases for the analysis of data collected on e-learning in Bangladesh. The data will first be pre-processed to verify its quality and reliability. In this process, duplicates are eliminated, missing values are handled, and formats are standardized in order to clean the data. After that, a thorough statistical analysis will be carried out to answer the following research questions:

- What are the elements driving the rise of e-learning in Bangladesh?
- What are the possible future opportunities for online education in Bangladesh?

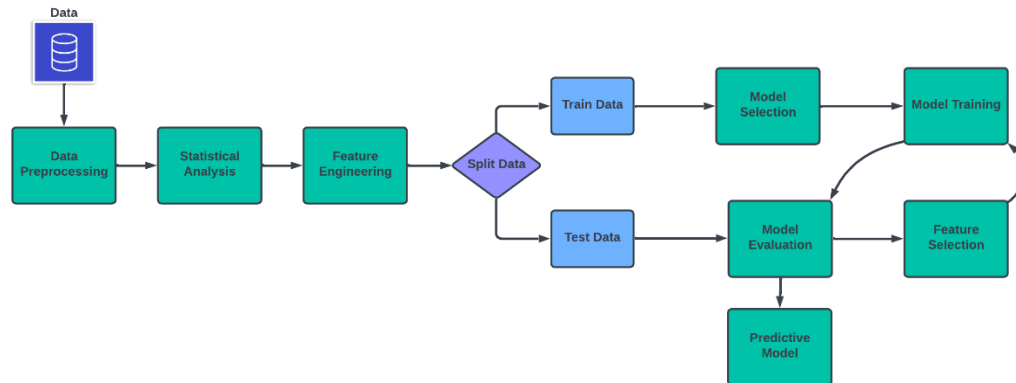


Figure 3.3.1. Proposed Methodology

We will use machine learning classification algorithms to look at potential future prospects for online education in Bangladesh. We will set the question "Do you think online education can fully replace traditional education?" as the target feature. Multiple classification methods of machine learning will be used to forecast this objective characteristic, with the goal of identifying and analyzing the important aspects that lead to the belief that online education has the capacity to replace traditional education. Following that, feature engineering will be used to extract and develop significant features from the raw data, hence improving its predictive usefulness. Finally, we will select the best-performing model.

We will compare these models based on their classification accuracy and show the models' performance:

- **Logistic Regression (LR):** A popular statistical model for binary classification problems that forecasts binary outcomes based on predictor factors.
- **Gaussian Naïve Bayes (NB):** This probabilistic classifier leverages Bayes' theorem and assumes independence among features, making it particularly useful for high-dimensional datasets.
- **Support Vector Machine (SVM):** SVM finds the ideal hyperplane to divide data into discrete classes, and is well-known for its effectiveness in high-dimensional fields.
- **K-Neighbors Neighbors (KNN):** Data points are categorized by KNN according to the majority class of the neighbors that are closest to them.

- **Random Forest (RF):** An ensemble approach to improve prediction accuracy and manage overfitting by building many decision trees and combining their output.
- **Decision Tree (DT):** This technique creates a tree structure for classification by dividing the data into subgroups according to the most important feature.
- **Gradient Boosting (XGB Classifier):** This powerful ensemble approach creates models progressively, with each rectifying the flaws of its previous, and is noted for its high forecast accuracy.

The research seeks to offer a thorough insight into the present circumstances behind and potential futures for e-learning in Bangladesh by combining various techniques.

3.4 Hardware/ Software Requirement

This research on the emergence and possibilities of e-learning in Bangladesh requires the following hardware and software resources:

Hardware requirements include a modern computer or laptop with at least 8GB RAM and an Intel i5 processor, or similar for completing analysis tasks efficiently. Reliable high-speed internet access is required for conducting online surveys, using cloud-based technologies, and obtaining additional information. A portable hard drive or USB flash drive for data backup and information transfer.

Microsoft Word is used for writing and formatting research papers. The survey, which captured both quantitative and qualitative data from participants, was designed and distributed using Google Forms. To organize and manage survey data before analyzing it, we used Google Sheets or Microsoft Excel. Google Colaboratory will be used to preprocess data, engineer features, and conduct analyses.

These hardware and software resources are necessary to complete the research project's many stages, such as data collection, analysis, and reporting.

3.5 Project Management and Financial Analysis

To make sure that research activities are completed on time, a timeline was proposed. The resources needed for software use, data analysis, and gathering are determined and budgeted appropriately. The research approach incorporates ethical concerns to guarantee informed consent, anonymity, and privacy of data. Here is an estimated budget for the study:

Table 3.5.1. Expenditure Details

SN	Components	Estimated Cost (BDT)
01.	Visiting Stakeholders	500-1000
02.	Data Collection and Processing	2500-3000
03.	Documentation and Report Writing	500-1000
04.	Miscellaneous	500-1000
05.	Contingency (10% of total)	1000-1500
Total Estimated Cost		5,000-7,500

3.6 Summary

The research process involves collecting data through a Google Form survey and analyzing both quantitative and qualitative data using statistical methods. The research technique includes data collection, proposed methodology, hardware/software requirements, project management and financial analysis. These phases are intended to fully meet the study objectives, providing insights into the rise and future possibilities of e-learning in Bangladesh. The approach enables effective and fast data management from initial collection to final analysis, combining qualitative insights and quantitative measurements to provide a comprehensive picture of regional e-learning trends and prospects.

CHAPTER 4

IMPLEMENTATION

4.1 Overview

This study focuses on methodically analyzing data collected via the Google Form survey. This contains both quantitative and qualitative data, which are analyzed statistically to yield insights that are relevant to the research aims. The approach assures that the findings are accurate, reliable, and valid, resulting in a full understanding of e-learning in Bangladesh.

4.2 Data Preprocessing and Cleaning

The first steps are data preprocessing and cleaning, which ensure that the dataset is error-free, no duplicates, and consistent. This includes resolving missing values, standardizing data formats, and ensuring that all responses are complete and valid. The quality of the following analysis is dependent on the integrity of the data.

4.3 Feature Engineering

Feature engineering is an important stage in the machine learning process, converting raw data into useful features that improve model performance. Here is the description of the process of encoding categorical data:

- **Label Encoding:** Label encoding is a method that converts category columns into numerical. For example, the variable "gender" with the categories "Female" and "Male" is labeled as 0,1 accordingly.
- **Ordinal Encoding:** Ordinal encoding is a method for transforming categorical data into numerical while keeping the inherent order of the categories. For example, the variable "Internet Reliability" with the categories "Very Reliable", "Somewhat Reliable" and "Not Reliable" is labeled as 2, 1, and 0 respectively.
- **One-Hot Encoding (Using `get_dummies`):** When dealing with nominal categorical variables without an inherent order, one-hot encoding is used. This approach generates binary columns for each category, reflecting its existence or absence in the original data. For example, the variable "Device Used" containing the categories "Smartphone," "Laptop," and "Tablet" is split into three binary columns, one for each device type. This encoding is performed using Pandas' `get_dummies` function.

4.4 Train Model

Building machine learning models to forecast future prospects for online learning in Bangladesh, with an emphasis on whether online learning can completely replace traditional education, depends on the training phase. Below is a summary of the steps that are engaged in this phase:

- **Data Splitting:** The dataset is divided into training and testing sets prior to model training. The model was trained using 75% of the available data, with the remaining 25% set aside for performance testing. The evaluation of the model based on its ability to generalize to new data is ensured by this split.
- **Model Selection:** To find the best-performing model for our classification problem, a variety of machine learning models are chosen. The following classifiers are used: LR, Gaussian NB, SVM, KNN, RF, DT, and XGB, These models were selected because they have a proven record of successfully solving categorization issues.
- **Model Training:** The training dataset is used to train every model that was chosen. In order for the models to correctly predict the target feature, they must learn from the input features. The target feature contains three categories: Yes, No, Maybe. During training, the models alter their parameters to reduce prediction errors, hence increasing accuracy.

4.5 Model Optimization and Evaluation

We implemented feature selection techniques to enhance model accuracy. We utilized SelectKBest, Chi-Square (chi2), and ExtraTreesClassifier to identify and eliminate features with minimal impact on our predictive model.

Following training, the models are evaluated on a testing set using a range of performance measures such as accuracy, precision, recall, F1-score, and confusion matrix. These indicators give a thorough knowledge of each model's performance, showing both its strengths and places for development. Accuracy measures the model's overall accuracy, whereas precision and recall provide light on the model's capacity to appropriately recognize positive occurrences and record all relevant instances accordingly. A single measure that takes into consideration both false positives and false negatives is the F1-score, which is a harmonic mean of accuracy and recall that balances the trade-off between the two. By displaying true positives, true negatives, false positives, and false negatives, the confusion matrix breaks down the performance even further and helps in identifying specific areas where the model could be flawed. This thorough review ensures that the chosen model is strong and trustworthy in forecasting Bangladesh's prospects for online learning in the future.

4.6 Statistical Analysis

Statistical analysis of preprocessed data is crucial to the implementation phase. The analysis seeks to provide answers to the following research questions:

1. Elements Boosting the Rise of E-Learning in Bangladesh:
 - Identifying relationships between demographic parameters (such as age, education level, and geography) and access to online learning resources.
 - Model the impact of variables such as internet reliability, device usage, and hours spent on online learning on students' perceptions of education quality.
 - Summarize data and illustrate trends in accessibility, usage patterns, and quality ratings.
2. Future Prospects for Online Education in Bangladesh:
 - Investigates how present levels of engagement and pleasure predict future preferences for online learning.

4.7 Visualization

Data visualization tools are used to convey findings clearly. Graphs, charts, and tables are used to highlight trends, correlations, and patterns discovered throughout the statistical investigation, making the findings more understandable to a wider audience, including stakeholders and policymakers.

4.8 Interpretation of Results

The statistical analysis results are evaluated to answer the study questions.

- Elements driving the Rise of E-Learning: Identifying important aspects such as technological access, digital literacy, and socioeconomic effects.
- Future opportunities: Highlighting possible development areas and prospects for improving online education in Bangladesh.

4.9 Summary

The implementation step analyzes the acquired data using statistical methods to ensure robust and reliable outcomes. This phase gives complete insights into Bangladesh's current and future e-learning potential through data pretreatment, statistical analysis, visualization, and result interpretation. These findings have significance for guiding educational initiatives, policymaking, and funding decisions, ultimately contributing to the growth of online education in the region.

CHAPTER 5

RESULT AND ANALYSIS

5.1 Overview

The study results are aimed at discovering the factors driving the rise of e-learning in Bangladesh and inspecting future potential. It includes questions about accessibility, quality, involvement, problems, rewards, and future prospects, giving a comprehensive picture of the state of online education today. Both quantitative and qualitative analyses are made to attain insight into Bangladesh's e-learning progress and potential. Quantitative data is evaluated to detect trends and correlations, and qualitative data provides more in-depth insights into the participants' experiences and viewpoints. This dual approach provided a complete knowledge of the forces driving the growth of e-learning, as well as the challenges and opportunities it brings. This report seeks to enlighten stakeholders on the current landscape and future possibilities of online education in Bangladesh, to direct strategic decisions and policymaking.

5.2 Statistical Analysis

The demographic information in *Table 5.2.1* offers a complete picture of the participants. The majority of responders (48.5%) were between the ages of 23 and 27, with a considerable number in the 18-22 age group (43.8%). The gender distribution was mostly male (76.7%), with females weighing 23.3% of the sample. Geographically, participation was primarily from Dhaka (54.7%) and Rangpur (29.7%), with smaller numbers from other divisions. The majority of responders (80%) lived in cities, indicating more urban engagement. In terms of education, the majority were undergraduate students (74.25%), followed by those in postgraduate (11.6%) and higher secondary school (7.17%). The employment situation differed, with a large percentage (52.5%) jobless, followed by those working part-time (18.5%), self-employed (15.3%), freelance (9.7%), and full-time (4%).

Below is a table summarizing the demographic information of the survey respondents:

Table 5.2.1. Respondents' Demographic Information

Demographic Category	Options	Number of Responses	Percentage (%)
Age Group	Under 18	22	5.5
	18-22	177	43.8
	23-27	196	48.5
	28-32	8	2
	Over 32	1	0.2
Gender	Male	310	76.7
	Female	94	23.3
Division resides in	Dhaka	221	54.7
	Chittagong	12	3
	Khulna	15	3.7
	Rajshahi	16	4
	Barisal	9	2.2
	Sylhet	6	1.5
	Rangpur	120	29.7
	Mymensingh	5	1.2
Location	Urban	323	80
	Rural	81	20

Educational Background	Secondary School	20	5
	Higher Secondary School	29	7.17
	Undergraduate	300	74.25
	Postgraduate	47	11.6
	Other	8	1.98
Employment Status	Employed full-time	16	4
	Employed part-time	75	18.5
	Self-employed	62	15.3
	Freelancer	39	9.7
	Unemployed	212	52.5

Elements Driving the Rise of E-learning in Bangladesh

1. Technological Access and Usage:

- Internet Access:** A large proportion of respondents, 98.8%, reported having regular internet connectivity, which is essential for online learning. Moreover, 50.5% said their internet connection was highly reliable, and 34.2% found it somewhat reliable, indicating a strong foundation for e-learning growth. This broad internet connection serves as an essential basis for the growth of online education, ensuring that the great majority of students may engage in e-learning activities without experiencing severe connectivity issues.

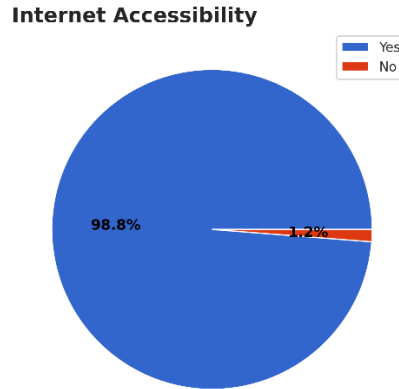


Figure 5.2.1. Regular Access to the Internet

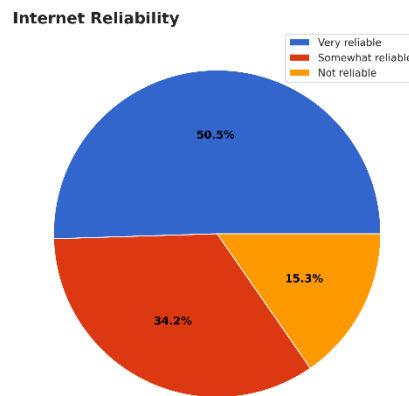


Figure 5.2.2. Reliability of Internet Connection

- Device Usage:** According to the survey, smartphones are the primary device used for online learning by 60.9% of respondents, followed by laptops (28%). This highlights the effectiveness of mobile-friendly learning platforms in reaching the majority of students. The widespread use of smartphones indicates that e-learning systems designed for mobile devices can considerably improve accessibility and convenience, allowing students to engage with educational information at any time and from any location.

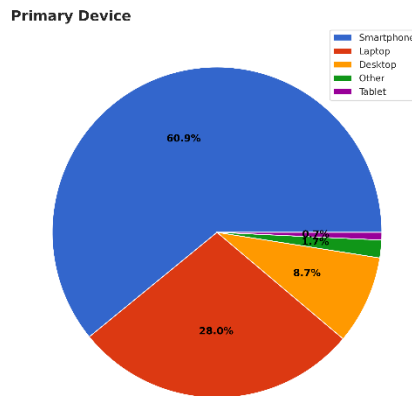


Figure 5.2.3. Primarily used device for Online Learning

- Learning Hours:** About 51.5% of students use online learning resources for less than five hours a week on average, while 32.9% spend five to ten hours. Most of them use YouTube for online learning, followed by Zoom. This demonstrates a significant level of involvement, with chances for more participation as the learning experience improves. The high level of engagement with online learning platforms demonstrates a good trend of incorporating digital resources into everyday study routines, resulting in a more flexible and adaptive learning environment that may meet the requirements of individual students.

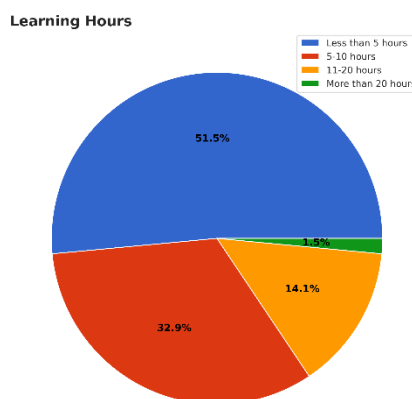


Figure 5.2.4. Hours spent per week on Online Learning activities

2. Quality of Online Education:

- **Course Quality:** The majority of students said the quality of online courses was good (34.9%) or excellent (33.4%), showing a positive perception of e-learning content. These assessments emphasize ongoing modifications in course content and delivery to satisfy student expectations, which contributes to online education's growing popularity and acceptability.

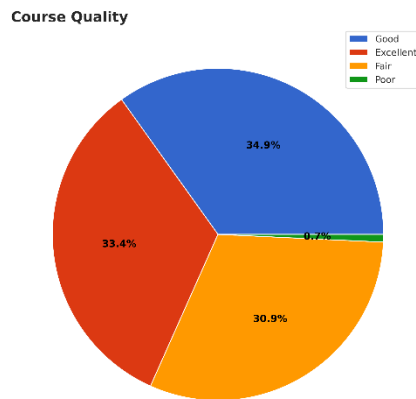


Figure 5.2.5. Quality of the Courses taken

- **Effectiveness and Engagement:** A notable 33.7% of students find online classes more effective than traditional in-person classes, and 33.7% find them equally effective. Furthermore, 60% feel engaged during online classes compared to traditional classes. These numbers show that a significant proportion of students are keen on the efficiency and engagement potential of online learning, which may have a beneficial effect on the growth of e-learning.

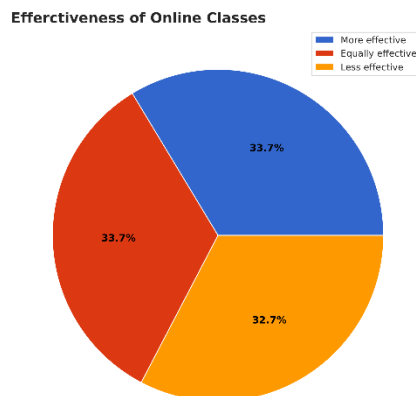


Figure 5.2.6. Effectiveness of online classes

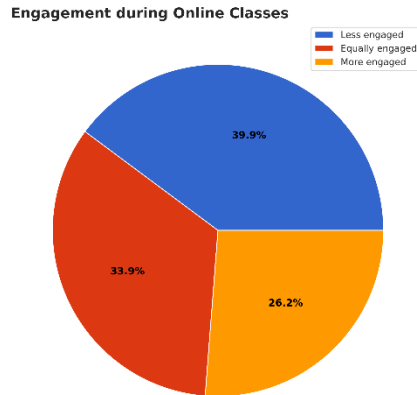


Figure 5.2.7. Engagement during Online classes

- Collaborative Learning Opportunities:** An encouraging 76.5% of students believe that online learning provides sufficient opportunities for collaborative learning. Additionally, 82.7% think online learning has improved their technical skills. These factors highlight the numerous advantages of online education, which is driving its expansion and use.

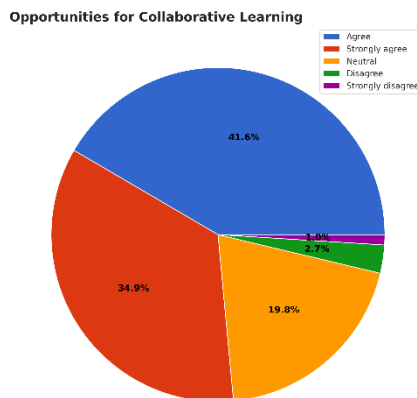


Figure 5.2.8. Opportunities for Collaborative Learning

Challenges and Barriers:

- Technical Issues:** A significant 57.2% of students reported experiencing technical difficulties, with many suffering connectivity issues throughout online sessions. These technological limitations are a major hindrance to efficient online learning. Despite the growing popularity of e-learning, poor internet connections, and frequent technological disruptions hamper the seamless delivery of online education. This emphasizes the critical requirement

for dependable technical support and solid infrastructure to guarantee that students can access and interact with online learning resources without interruption.

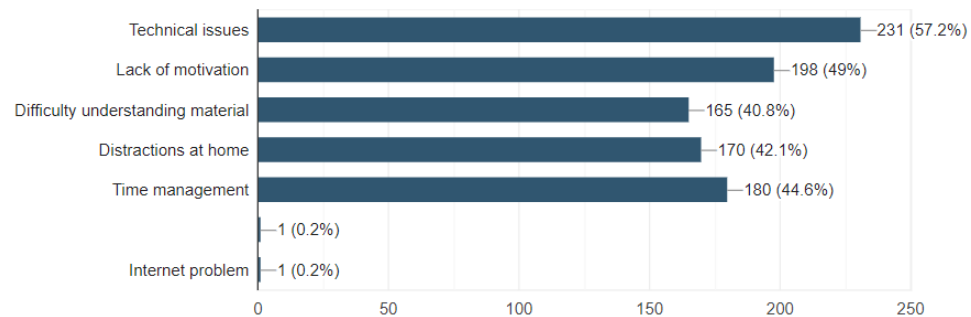


Figure 5.2.9. Main challenges faced by online learning

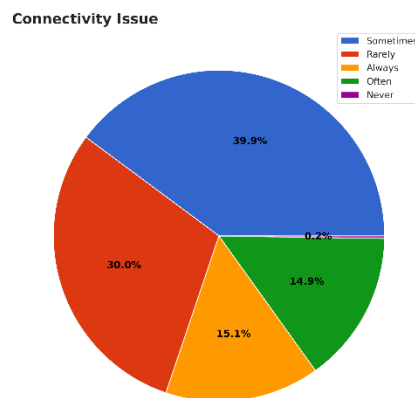


Figure 5.2.10. Connectivity issues during online classes

- Motivation and Distractions:** A total of 91% of students report a lack of motivation and distractions when learning at home, which provides a significant barrier to the efficacy of e-learning. To make matters worse, 69.8% of students said they experienced feelings of isolation when taking classes online. These characteristics emphasize the need to provide interesting and dynamic online learning environments that keep students motivated and engaged. The lack of physical presence and social contact in online classrooms can contribute to feelings of isolation and lower participation, making it critical to establish tactics that build an environment of community and support among students. Addressing these issues is critical for improving the overall learning experience while also assuring the long-term viability and sustainability of Bangladesh's e-learning programs.

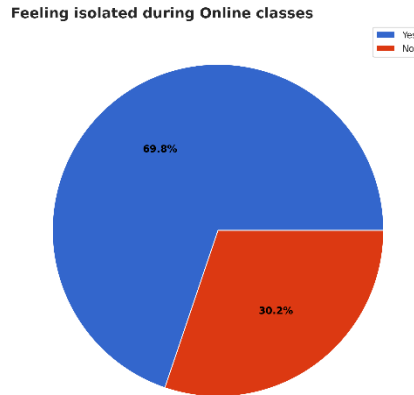


Figure 5.2.11. Feeling isolated during online classes

Future Opportunities for Online Education in Bangladesh

The survey results show that online education in Bangladesh has a promising future. Approximately 65% of students expect that online education will become more widely available in the next years. The substantial percentage of students who have embraced and adjusted to online learning during the pandemic supports this view.

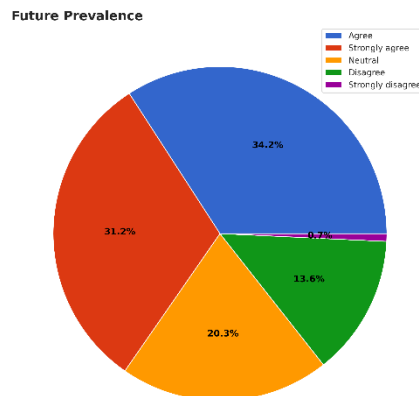


Figure 5.2.12. Opinions on the future prevalence

of online education in Bangladesh

Additionally, 67.6% of students showed a desire to continue with online learning even once regular classes resumed. This suggests a significant preference for the ease and flexibility that come with online learning. The desire of such a big number

of students to continue with online learning implies that there is a long-term need for digital education platforms in the nation.

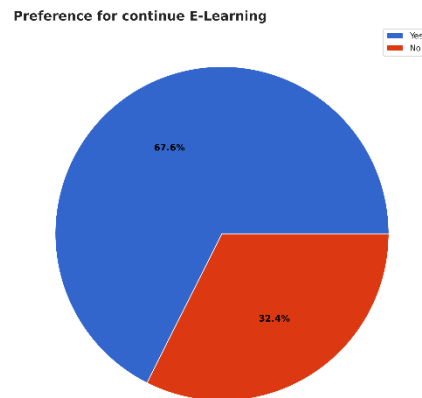


Figure 5.2.13. Preference for continued online learning even
after the resumption of traditional classes

An even more encouraging picture of e-learning in Bangladesh is provided by the student satisfaction statistics. Approximately 65% of students expressed satisfaction with their entire online learning experience. This level of satisfaction is significant because it shows how well online learning fulfills the requirements and expectations of students. Furthermore, around 65% of participants believe that online learning has fulfilled their academic needs and expectations. This demonstrates the potential of online education to provide high-quality learning experiences that are equivalent to, if not greater than, those found in traditional classrooms.

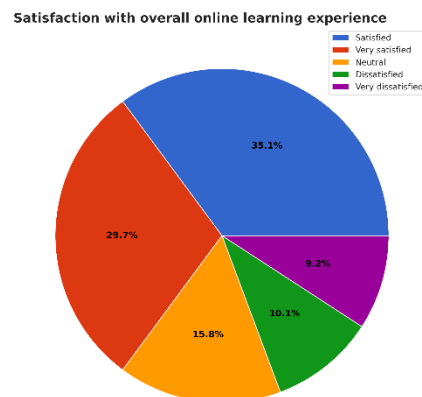


Figure 5.2.14. Satisfaction with overall online learning experience

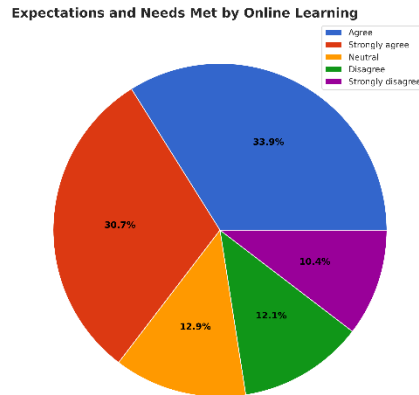


Figure 5.2.15. Opinions on whether online learning
has met academic needs and expectations

The majority of students believe that online learning has the potential to completely replace traditional education. This assumption reflects a substantial shift in how people perceive online learning. Students are realizing the advantages of digital education, such as access to a broader selection of courses and programs, the flexibility to learn at their own speed, and the ease of not having to go to a physical campus.

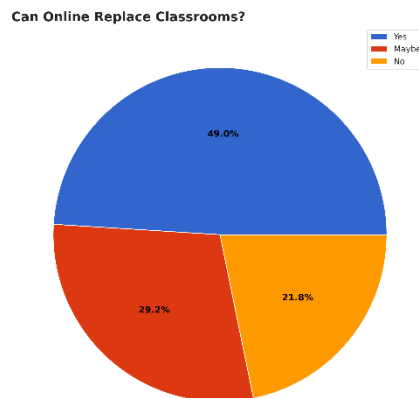


Figure 5.2.16. Opinions on whether online education
can fully replace traditional education

With encouraging student feedback, there are several aspects that need to be improved in order in order to boost future possibilities of online education in Bangladesh. Here are some significant recommendations based on participants' views:

1. Infrastructure Improvements:

- **Internet Infrastructure:** For 57% of students, having better internet infrastructure is of utmost importance. This points to a significant area for investment by the government and educational institutions. E-learning projects require reliable internet connectivity to succeed. Improving internet access will enable more students to participate in online learning without interruption.
- **Device Accessibility:** Many students (56%) emphasized the importance of having access to improved equipment and technologies. Equalizing access to the required hardware for all students will be essential to ensuring fairness in online learning. Providing affordable or subsidized devices can assist in closing the digital gap and ensure that all students have the resources they require to achieve their goals.

2. Interactive Content and Engagement:

- **Interactive Content:** An overwhelming majority of students—55%—suggest that there should be more interactive information available. Adding multimedia and interactive features to online courses may greatly improve engagement and learning results. This method can assist in alleviating challenges of motivation and distraction by making learning more dynamic and exciting.
- **Instructor Training:** A significant area for development, according to 55% of students, is instructor training. The general efficacy of e-learning can be raised by developing teachers' proficiency with online teaching techniques. Providing continual professional development opportunities and training sessions for teachers can help them deliver high-quality online education.

3. Support Services and Flexibility:

- **Student Support Services:** Many students considered enhanced support services, such as technical help and academic counseling, to be vital. Students' difficulties in an online learning environment can be mitigated by offering them complete assistance. The establishment of specialized helpdesks and support centers can aid students in resolving technological problems and academic difficulties.

- **Flexible Scheduling:** Providing more flexible schedule choices will be essential for supporting different learning styles and responsibilities. Flexibility makes online education more successful and accessible by enabling students to combine their studies with other responsibilities. One way to meet the requirements of individual students and enhance their overall learning experience is to provide asynchronous learning choices and different class schedules.

These positive attitudes toward online education imply that, with continuing improvements in internet infrastructure, course quality, and instructor preparedness, e-learning has the potential to transform Bangladesh's education system. Students' increasing acceptance and desire for online learning suggests that digital education is more than a temporary solution, but a feasible long-term choice. As Bangladesh continues to invest in technology and digital infrastructure, the possibilities for online education seem to be improving.

5.3 Experiment Result

The analysis we offer in this study uses several machine-learning classification methods to forecast Bangladesh's future potential for online education. To select the most effective classifier for our dataset, we tested models in a series of measurement experiments and compared their performance. We implemented seven distinct algorithms, each with unique strengths and methodologies. The models that are employed are Logistic Regression, Random Forest Classifier, K-Neighbors Classifier, Support Vector Classifier, Gaussian Naïve Bayes, Decision Tree, and XGBoost. *Figure 5.3.1* shows the accuracy of the models. The model that performed the best in terms of accuracy was the Random Forest Classifier (78.22%). Logistic Regression (77.23%) and XGB (76.24%) followed as the next best models. These models performed much better than others in terms of prediction accuracy.

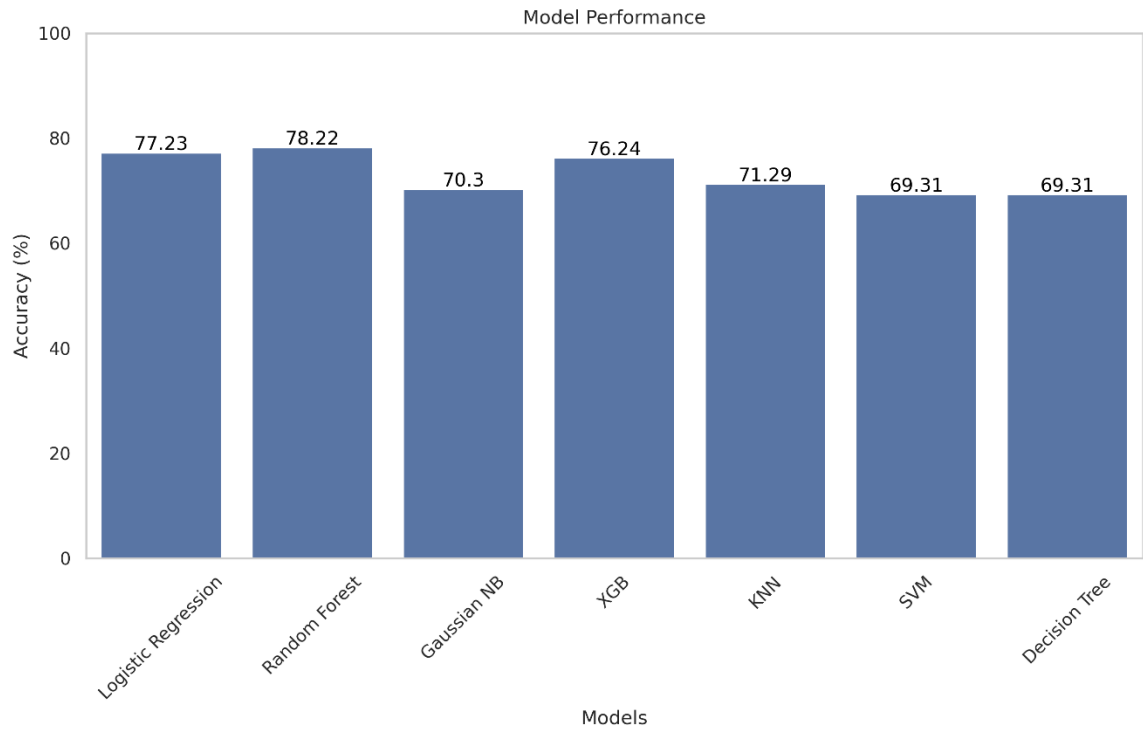


Figure 5.3.1. Accuracy of the models

The confusion matrix that details the model's performance is shown in *Figure 5.3.2*, and the comprehensive classification report, which provides an extensive analysis of model parameters including accuracy, recall, and F1-score across multiple classes(Maybe, No, Yes), is shown in *Figure 5.3.3*.

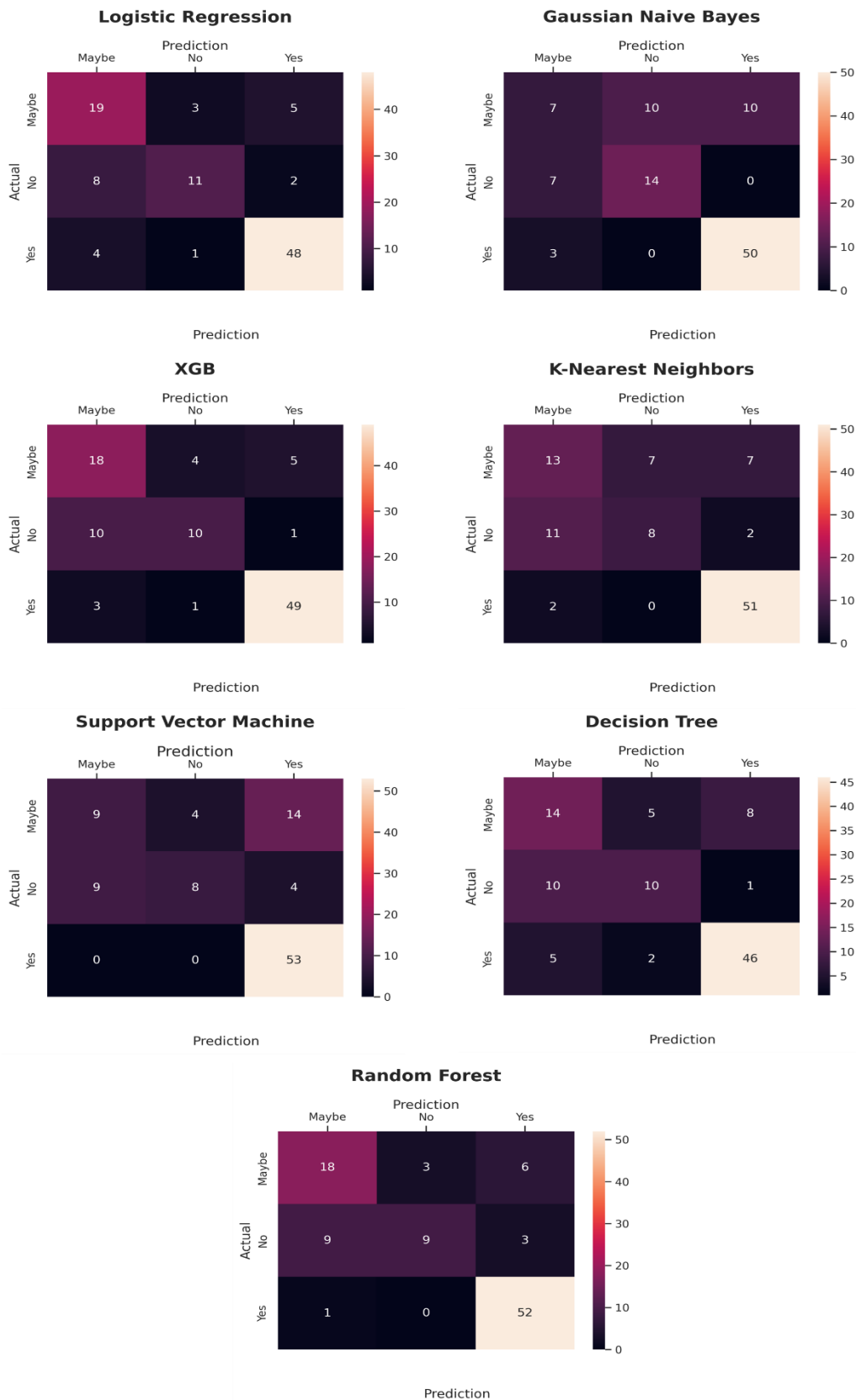


Figure 5.3.2. Confusion Matrix of the models

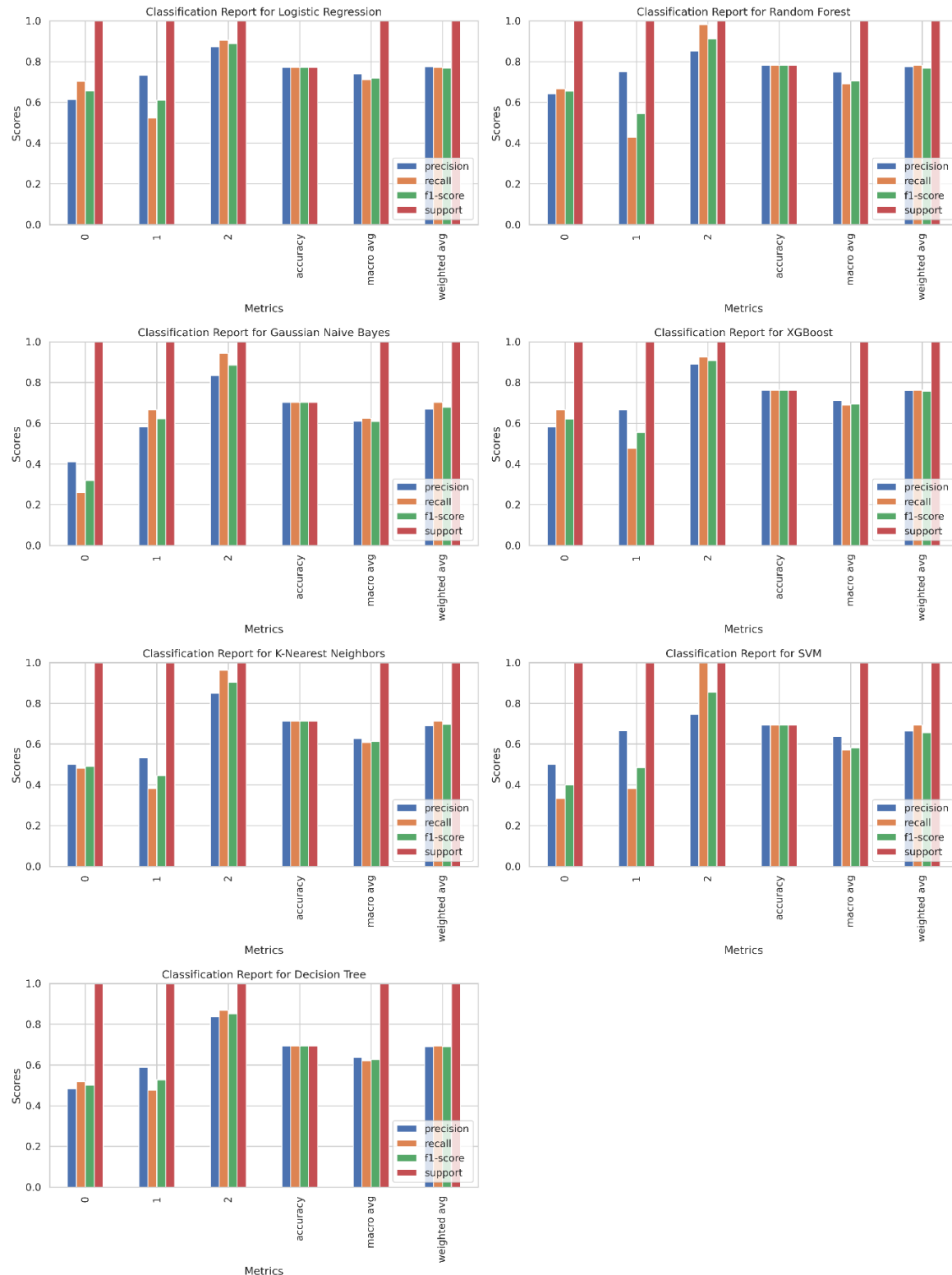


Figure 5.3.3. Classification Reports of the models

We implemented feature selection techniques to enhance model accuracy. Specifically, we utilized SelectKBest, Chi-Square (chi2), and ExtraTreesClassifier to identify and eliminate features with minimal impact on our predictive model. With the use of these techniques, we were able to measure each feature's influence on the model's performance in detail. SelectKBest, leveraging the chi-squared statistical test, identified key features based on their statistical significance. Concurrently, ExtraTreesClassifier, an ensemble learning method, provided feature importance rankings by assessing the contribution of each feature to the decision trees within the ensemble. By combining these approaches, we gained a comprehensive understanding of which features were most critical and which could be excluded without compromising, and even potentially enhancing, the model's performance. The features identified for elimination were 'age_28-32', 'division_Mymensingh', 'division_Sylhet', and 'primary_device_Tablet'. This refined feature set significantly increased the accuracy of our Random Forest model compared to the previous performance (shown in *Figure 5.3.4*). Ultimately, these feature selection steps were crucial in optimizing our model, allowing us to achieve the highest possible accuracy.

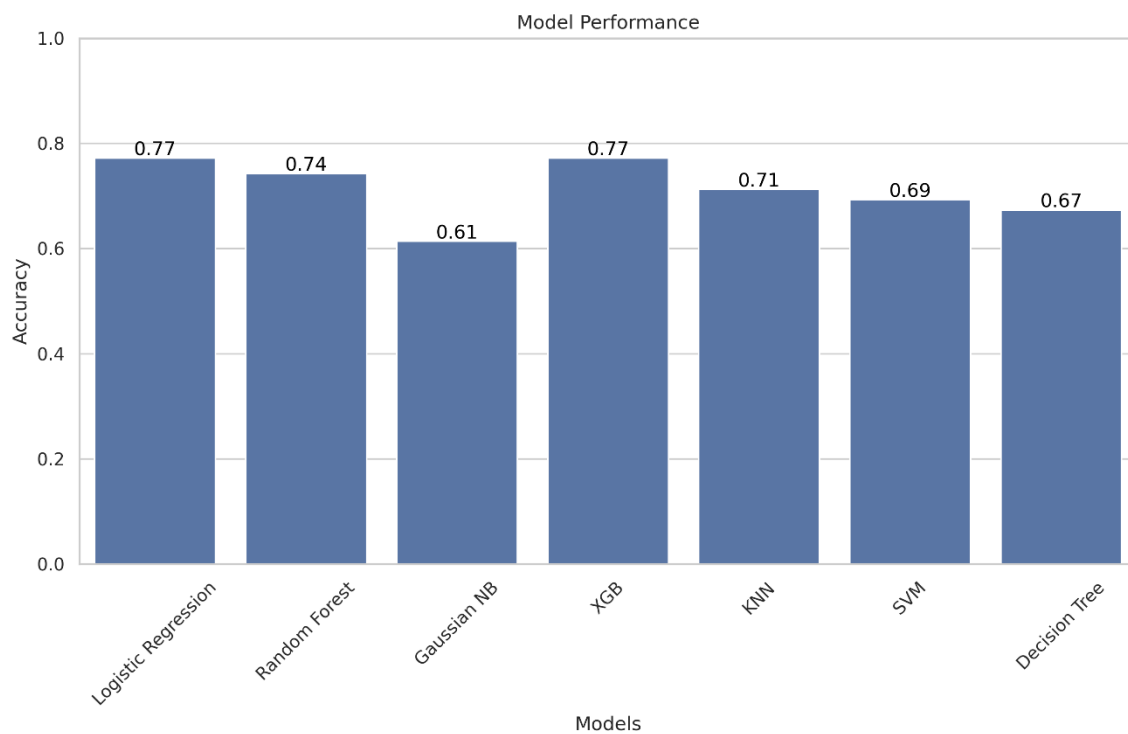


Figure 5.3.4. Accuracy of the models before applying the Feature Selection technique

ROC curves (*Figure 5.3.5*) illustrating the results of seven machine learning models on a multiclass classification task: Decision Tree, XGBoost, K-Nearest Neighbors, Support Vector Machine, Gaussian Naïve Bayes, and Logistic Regression. Each curve depicts the models' ability to discriminate across classes, as determined by the Area Under the Curve (AUC) score, emphasizing their discriminating abilities across different classes.

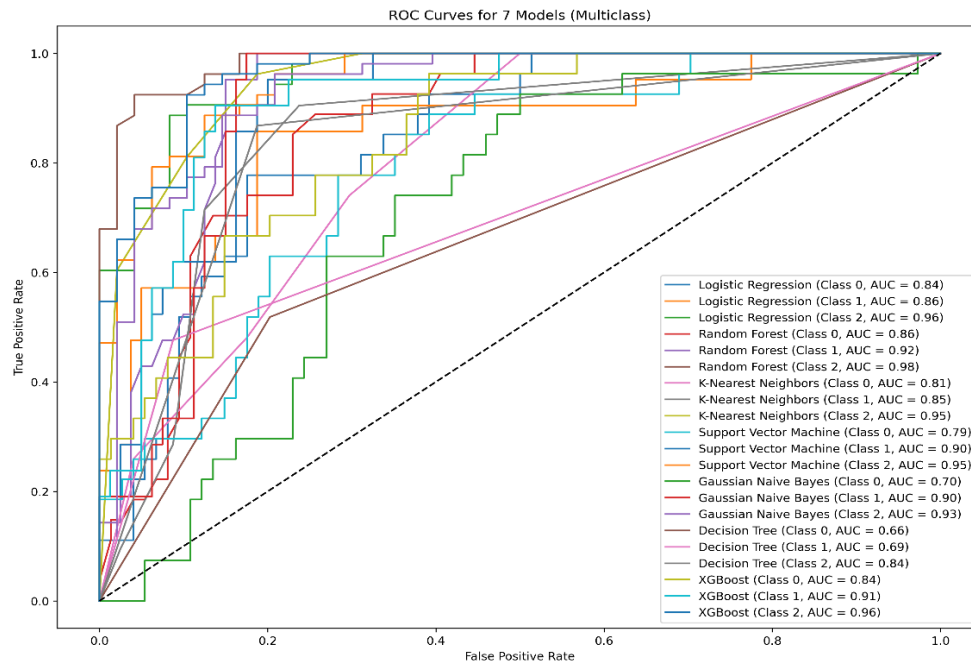


Figure 5.3.5. Multiclass Receiver Operating Characteristic (ROC) of the models

The best-performing model:

The **Random Forest** classifier outperformed the other algorithms, attaining the highest precision. The RF classifier's confusion matrix (*Figure 5.3.2*) demonstrates that it made the fewest amount of misclassifications, demonstrating its robustness and accuracy. Its exceptional performance is highlighted in the classification report (*Figure 5.3.3*) by a number of indicators, including accuracy, recall, and F1-score. These findings support the RF classifier's predictive power for online learning possibilities in Bangladesh, hence establishing its validity as a model for this study.

Finally, the RF classifier performed the best, followed by the Logistic Regression and XGB. These results indicate that group approaches, in particular boosting strategies, work very well for this categorization job, providing important information for future educational planning and strategy development in Bangladesh.

5.4 Summary

The study results provided some significant insights into the situation of e-learning in Bangladesh. A remarkable 93.8% of respondents reported frequent internet connectivity, with 51.9% describing their connection as highly stable and 42% as fairly reliable. This ubiquitous internet access serves as a solid platform for the expansion of e-learning. Smartphones are the primary device for 52.3% of students, highlighting the necessity of mobile-friendly platforms. Engagement levels are modest, with 45.7% utilizing online resources for 5-10 hours each week. The majority of students assessed the course quality positively, with 54.3% saying it was good. While 32.1% thought online classes were more successful than traditional ones, 55.5% appreciated collaborative learning possibilities online. Still, there is room for improvement—63% reported technical problems, while 86% reported difficulties with motivation. The future prospects are promising, with 65% expecting a growing prevalence of online education and 76.5% wishing to continue e-learning beyond the epidemic, indicating a long-term need for digital education in Bangladesh. Different machine learning algorithms were used to evaluate if online learning might replace conventional ways of education. By utilizing a variety of factors, the algorithms were able to predict outcomes with an accuracy of 78.22%.

CHAPTER 6

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

6.1 Impact on Life

E-learning has drastically changed the educational scene in Bangladesh, providing both benefits and problems. Its effect goes beyond education, impacting a variety of socioeconomic, environmental, and sustainability issues. This section explores these effects, examining how e-learning changes people's lives, deals with moral dilemmas, and promotes sustainability. E-learning has the potential to reduce educational gaps and create a more equitable learning environment by utilizing technology.

6.2 Impact on Society & Environment

E-learning has made education more accessible to students living in distant and underprivileged places. This has balanced the playing field, opening up chances for individuals who previously lacked access to high-quality education. According to UNESCO, "Digital learning platforms can bridge the education gap for millions of students globally" [12]. E-learning's flexibility also supports a variety of learning styles and schedules, allowing students to combine their education with other activities. Additionally, online education provides chances for lifelong learning, allowing people to retrain and upskill in response to shifting demands in the job market.

6.3 Ethical Aspects

Diversity and data privacy are at the core of e-learning's moral implications. It is critical that all students, regardless of financial status, have access to the technology they require. Additionally, protecting students' personal information is critical to maintaining trust and security in online learning environments. According to the World Economic Forum, "Protecting student data is paramount to preserving the integrity and trust of digital education systems" [13]. Ensuring equal access to digital resources through collaborative efforts between governments, educational institutions, and the corporate sector presents another ethical challenge.

6.4 Sustainability Plan

E-learning helps environmental sustainability by minimizing the need for physical infrastructure and moving around, resulting in decreased carbon emissions. According to an Open University research, "Distance learning courses consume nearly 90% less

energy and produce 85% fewer CO2 emissions than traditional campus-based courses" [14]. To improve sustainability, ongoing investments in renewable energy and eco-friendly digital learning tools are required. Encouraging the usage of energy-efficient equipment and fostering digital literacy can help to strengthen e-learning's sustainability. Furthermore, digital learning minimizes the demand for printed materials, saving natural resources and minimizing waste. Overall, online education reduced transportation emissions, decreased demand for physical resources, and diminished reliance on paper contributing to its eco-friendliness [15].

6.5 Summary

The transition to e-learning in Bangladesh has benefited society by increasing access to education and boosting environmental sustainability. However, resolving ethical concerns and ensuring equal access to technology remains crucial. E-learning may continue to be a revolutionary force in education and society by encouraging a balanced approach that blends technology improvements with ethical concerns and sustainability strategies. The future of e-learning in Bangladesh seems bright, provided that these problems are tackled with creative approaches and cooperative efforts.

CHAPTER 7

CONCLUSION AND FUTURE WORK

7.1 Conclusions

The emergence of e-learning in Bangladesh has shown significant advancements in a number of educational areas. Increased smartphone usage, improved internet access, and substantial interaction with digital learning platforms have established a strong foundation for the nation's online education future. This research looked at students' experiences and perceptions of e-learning in Bangladesh. The survey data indicates that students have a favorable opinion of the efficacy, affordability, and quality of online education. However, technological obstacles, a lack of motivation, and feelings of isolation are significant challenges that must be addressed to ensure the longevity and effectiveness of e-learning initiatives. Continuous advancements in digital infrastructure, interactive material, and support services are essential for accelerating e-learning's positive influence on society, the environment, and sustainability.

The study emphasized the potential of e-learning to close the educational gap and give alternative learning possibilities in Bangladesh. However, considerable changes are required to provide a more inclusive and successful online learning experience for all students.

7.2 Further Suggested Work

To expand on the existing findings, future study is advised in the following areas:

- **Enhanced Technical Support:** Look at the adoption of strong technical support solutions to reduce interruptions in online learning. This might include real-time problem-solving services and full IT assistance for students and teachers.
- **Engagement techniques:** Create and test innovative techniques to increase student engagement and motivation. To boost involvement and lessen feelings of isolation, interactive learning modules, online study groups, and peer mentorship programs should be investigated.
- **Hybrid Learning Models:** Investigate the use of hybrid learning models that integrate online and in-person programs. This strategy might overcome the

constraints of both methodologies, resulting in a more flexible and effective learning experience.

- **Longitudinal research:** Conduct long-term research to determine the influence of e-learning on academic achievement, skill development, and career outcomes. This research can shed light on digital education's prospective sustainability and efficacy.
- **In-depth Exploration of Challenges:** Conduct qualitative research to acquire a more detailed insight into the particular challenges that students encounter when studying online, including motivation, self-discipline, and time management.

7.3 Limitations/ Conflict of Interests

The study contains various limitations that should be considered. First, because the survey data is self-reported, it could lead to bias and alter the accuracy of the conclusions. Furthermore, the sample size and demographic dispersion may not adequately capture the variety of Bangladesh's student population. Future studies should try to include a wider and more representative sample to improve the results' generalizability. Additionally, this research does not include any conflicts of interest.

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Appendix A

Course Outcomes, Complex Engineering Problems (EP) and Complex Engineering Activities (EA) Addressing

Title:

E-Learning Emergence: A Comprehensive Analysis of Online Education's Expansion and Prospects in Bangladesh

Student ID: 201-15-13839

CO Description for FYDP

CO	CO Descriptions	PO
Phase -I		
CO1	Integrate recently gained and previously acquired knowledge to identify E-Learning Emergence for the Final Year Design Project (FYDP)	PO1
CO2	Analyze different aspects of the goals in designing a solution for this FYDP	PO2
CO3	Explore diverse problem domains through a literature review, delineate the issues, and establish this goals for the FYDP	PO4
CO4	Perform economic evaluation and cost estimation and employ suitable project management procedures throughout the development life cycle of the FYDP	PO11
Phase -II		
CO5	Design and develop technical solutions and system components or processes that meet specified requirements, ensuring compliance with public health and safety standards, as well as considering cultural, socioeconomic, and environmental factors in this FYDP	PO3
CO6	Choose and apply appropriate methodologies, resources, and contemporary engineering and IT technologies to address complex engineering processes, encompassing prediction and modeling, while adhering to relevant constraints in this FYDP	PO5
CO7	Analyze societal, health, safety, legal, and cultural considerations, along with associated responsibilities, in the context of professional engineering practice and the resolution of this problem, employing logical reasoning guided by contextual understanding.	PO6
CO8	Comprehend and evaluate the enduring sustainability and impact of professional engineering endeavors in addressing intricate engineering challenges within social and environmental frameworks.	PO7
CO9	Implement ethical principles and adhere to professional standards and norms in this FYDP	PO8

CO10	Capable of operating proficiently both individually and as a team member or leader across diverse teams and interdisciplinary settings in this FYDP.	PO9
CO11	Proficiently communicate with the engineering community and broader society regarding complex engineering endeavors, including the ability to comprehend and generate comprehensive reports and design documentation, as well as provide and receive clear instructions throughout this FYDP.	PO10
CO12	Acknowledge the importance of self-directed and life-long learning within the evolving landscape of technology, and possess the readiness and capability to engage in lifelong learning endeavors.	PO12

Addressing CO (1 to 8), Knowledge Profile (K), Attainment of Complex Engineering Problems (EP), and Attainment of Complex Engineering Activities (EA)

Addressing CO (1 to 8), Knowledge Profile (K), Attainment of Complex Engineering Problems (EP):

SN	EP Definition	Attainment	CO	Justification (with Knowledge Profile)	References
1.	EP1: Depth of Knowledge required	Yes	CO1, CO2, CO3, CO5, CO6, CO7 and CO8	This study requires data collection from the students by a Google Form and we must analyze the data for further process. Also, we need to do mathematical calculations that cover mathematics (K2). This study demonstrates engineering fundamentals (K3) principles by employing advanced statistical analysis, data preprocessing, and feature engineering techniques to identify key challenges and opportunities in e-learning. This study applies machine learning algorithms that address Specialist Knowledge (K2)	Page no: [8] Section: [3.2] Page no: [15-33] Section: [5.2,5.3]

				The study applies engineering practice & design (K5) by developing robust methodologies for analyzing survey data and implementing technical solutions.	Page no: [8-10] Section: [3.3]
				This study ensures K8 (Research Literature) by synthesizing insights from recent studies on e-learning, showcasing a comprehensive understanding of current methodologies and their application in the context of Bangladesh.	Page no: [4-6] Section: [2.2, 2.3]
2.	EP2: Range of Conflicting Requirements	Yes	CO2 and CO7	This study addresses EP-2 through numerous restrictions, such as the survey data being self-reported, which may contribute to bias and change the accuracy of the results. The sample size and demographic distribution may not accurately reflect the diversity of Bangladesh's student population.	Page no: [37] Section: [7.3]
3.	EP3: Depth of analysis required	Yes	CO2, and CO6	This project addresses EP-3 by thoroughly analyzing survey data to identify key factors affecting e-learning effectiveness, comparing different aspects, and proposing data-driven improvements.	Page no: [15-27] Section: [5.2]

4.	EP4: Familiarity of Issues	Yes	CO8	This project's multidisciplinary approach goes beyond engineering, influencing educational policy and practice in Bangladesh, and contributing to advances in online education and accessibility, indicating EP-4 .	Page no: [2] Section: [1.4,1.5]
5.	EP5: Extends of application codes	No	CO5	N/A	N/A
6.	EP6: Extends of stakeholders involved and conflicting	No	CO8	N/A	N/A
7.	EP7: Interdependence	Yes	CO5	This project's comprehensive approach addresses high-level problems by integrating various components across data collection, statistical analysis, application of machine learning algorithms, and proposed methodology, ensuring a holistic solution to complex challenges in online education.	Page no: [8-10] Section: [3.2, 3.3]

Addressing CO11 with Complex Engineering Activities (EA) [Some or all of the following]:

SN	EA Definition	Attainment	CO	Justification	References
1.	EA1: Range of resources	Yes	CO11	This project utilizes diverse resources such as high-performance computing infrastructure, reliable internet connection, and comprehensive datasets to analyze and enhance e-learning effectiveness in Bangladesh.	Page no: [10] Section: [3.4]
2.	EA2: Level of interaction	No		N/A	N/A
3.	EA3: Innovation	No		N/A	N/A
4.	EA4: Consequences for society and the environment	Yes		This project contributes to society by improving access to quality education through e-learning, promoting digital literacy, and reducing environmental impact by minimizing the need for physical infrastructure and commuting.	Page no: [34-35] Section: [6.1, 6.2, 6.4]

5.	EA-5: Familiarity	Yes		This project expands upon existing research by exploring innovative e-learning solutions and methodologies, demonstrated through a comprehensive literature review and statistical analysis, offering new insights into the field.	Page no: [4-6] Section: [2.2, 2.3]
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Addressing CO (4, 9, 10, and 12):

SN	COs	Attainment	Justification	References
1	CO4	Yes	Through the integration of efficient project management and financial oversight, this project addresses CO4 by ensuring careful planning, resource allocation, and budget estimate for the best possible resource utilization throughout the study's lifecycle.	Page no: [10-11] Section: [3.5]
2	CO9	Yes	The project demonstrates adherence to ethical principles by prioritizing participant privacy, obtaining informed consent, and transparently documenting the research process, ensuring responsible knowledge dissemination and societal well-being through the ethical application of advanced educational technologies that comply with CO9 .	Page no: [32] Section: [6.3]
3	CO10	No	N/A	N/A
4	CO12	Yes	The project's dedication to continuous learning (CO12) and adaptation within the dynamic technological landscape is reflected in its comprehensive data collection, statistical analysis, in-depth methodology development, applying ML algorithms, and thorough experimental results and analysis showcasing a commitment to staying updated and refining techniques to address modern challenges.	Page no: [8-10, 12-12, 15-31] Section: [3.2, 3.3, 3.4, 4.2, 4.3, 4.4, 5.2, 5.3]

Appendix B

Questionnaire

Section 1: Demographic Information

1. What is your age?
 - Under 18
 - 18-22
 - 23-27
 - 28-32
 - Over 32
2. What is your gender?
 - Male
 - Female
3. What level of education are you currently pursuing?
 - Secondary School
 - Higher Secondary School
 - Undergraduate
 - Postgraduate
 - Other (please specify)
4. What is your field of study?
 - Science
 - Arts
 - Commerce
 - Engineering
 - Medical
 - Other (please specify)
5. What is your employment status?
 - Employed full-time
 - Employed part-time
 - Self-employed
 - Freelancer
 - Unemployed
6. Which region of Bangladesh do you reside in?
 - Dhaka
 - Chittagong
 - Khulna
 - Rajshahi
 - Barisal
 - Sylhet
 - Rangpur
 - Mymensingh
7. What type of area do you reside in?
 - Urban
 - Rural

Section 2: Accessibility and Usage

8. Do you have regular access to the internet?
 - Yes
 - No
9. What type of device do you primarily use for online learning?
 - Smartphone
 - Laptop
 - Desktop
 - Tablet
 - Other (please specify)
10. How reliable is your internet connection?
 - Very reliable
 - Somewhat reliable
 - Not reliable
11. How many hours per week do you spend on online learning activities?
 - Less than 5 hours
 - 5-10 hours
 - 11-20 hours
 - More than 20 hours
12. Which platform(s) do you use for online learning? (Select all that apply)
 - Zoom
 - Google Classroom
 - Microsoft Teams
 - Moodle
 - Coursera
 - Khan Academy
 - Other (please specify)

Section 3: Quality of Online Education

13. How would you rate the quality of online courses you have taken?
 - Excellent
 - Good
 - Fair
 - Poor
14. Do you find online classes as effective as traditional in-person classes?
 - More effective
 - Equally effective
 - Less effective
15. Are the online course materials (videos, readings, assignments) well-organized and easy to follow?
 - Strongly agree
 - Agree
 - Neutral
 - Disagree

- Strongly disagree
- 16. How often do you experience technical difficulties during online classes?
 - Never
 - Rarely
 - Sometimes
 - Often
 - Always
- 17. Do you feel that your instructors are adequately prepared to teach online?
 - Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
- 18. Do you think student evaluation in online learning is fair?
 - Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree

Section 4: Engagement and Interaction

- 19. How engaged do you feel during online classes compared to traditional classes?
 - More engaged
 - Equally engaged
 - Less engaged
- 20. How often do you participate in online class discussions?
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never
- 21. Do you feel comfortable asking questions in an online class?
 - Yes
 - No
- 22. How satisfied are you with the level of interaction between students in online courses?
 - Very satisfied
 - Satisfied
 - Neutral
 - Dissatisfied
 - Very dissatisfied
- 23. Do you think online learning provides enough opportunities for collaborative learning?
 - Strongly agree
 - Agree

- Neutral
- Disagree
- Strongly disagree

Section 5: Challenges and Barriers

24. What are the main challenges you face with online learning? (Select all that apply)
- Technical issues
 - Lack of motivation
 - Distractions at home
 - Time management
 - Difficulty understanding material
 - Other (please specify)
25. How often do you encounter connectivity issues during online classes?
- Never
 - Rarely
 - Sometimes
 - Often
 - Always
26. Do you have a quiet and comfortable place to study at home?
- Yes
 - No
27. How do you manage your time for online studies compared to traditional studies?
- Better
 - Same
 - Worse
28. Do you feel isolated while studying online?
- Yes
 - No

Section 6: Benefits and Advantages

29. What do you think are the main benefits of online learning? (Select all that apply)
- Flexibility
 - Accessibility
 - Cost-effectiveness
 - Wide range of resources
 - Self-paced learning
 - Other (please specify)
30. Do you find online learning more affordable than traditional learning?
- Yes
 - No
31. Has online learning improved your technical skills?
- Yes
 - No

32. Do you think online education provides better access to a wider range of courses and programs?
- Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
33. Are you able to balance online studies with other responsibilities (e.g., work, family)?
- Yes
 - No

Section 7: Future Prospects

34. Do you believe online education will become more prevalent in Bangladesh in the future?
- Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
35. Would you prefer to continue with online learning even after traditional classes resume?
- Yes
 - No
36. What improvements would you like to see in online education? (Select all that apply)
- Better internet infrastructure
 - More interactive content
 - Improved instructor training
 - Enhanced student support services
 - Other (please specify)
37. How likely are you to recommend online learning to others?
- Very likely
 - Likely
 - Neutral
 - Unlikely
 - Very unlikely

Section 8: General Feedback

38. How satisfied are you with your overall online learning experience?
- Very satisfied
 - Satisfied

- Neutral
 - Dissatisfied
 - Very dissatisfied
39. Do you feel that online learning has met your academic needs and expectations?
- Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
40. How do you think the government and educational institutions can support online learning better? (Select all that apply)
- Improved internet infrastructure
 - Subsidized devices for students
 - Training programs for instructors
 - Enhanced digital literacy programs
 - Other
41. What specific features or tools do you think are missing in current online learning platforms? (Select all that apply)
- Better communication tools
 - More interactive content
 - Offline access to materials
 - Enhanced assessment methods
 - Other
42. Which of the following would most improve your online learning experience? (Select one)
- Improved internet infrastructure
 - More interactive content
 - Better instructor training
 - Enhanced student support services
 - Access to better devices and technology
 - More flexible scheduling options
 - Other
43. Do you think online education can fully replace traditional education?
- Yes
 - No
 - Maybe

E-LEARNING EMERGENCE: A COMPREHENSIVE ANALYSIS OF ONLINE EDUCATION'S EXPANSION AND PROSPECTS IN BANGLADESH

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