The Impact of AI and ChatGPT on Bangladeshi University Students: A Machine Learning Approach

By
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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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APPROVAL

This Project titled **"The Impact of AI and ChatGPT on Bangladeshi University Students: A Machine Learning Approach"**, submitted by Md Jhirul Islam, ID No: **211-15-4063** 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 12 January, 2025.

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DECLARATION

We hereby declare that this project has been done by us under the supervision of **Ms. Amatul Bushra Akhi**, **Assistant Professor,** Department of Computer Science and Engineering, 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

Artificial intelligence has completely digitalized modern education. Numerous cutting-edge AI tools, including ChatGPT and generative AI, are having an impact on our schooling. This study presents a scenario of how Chat GPT and AI affect Bangladeshi students' critical thinking and learning habits in the context of higher education. Using a qualitative survey form, we attempt to create an exclusive dataset. In order to create this dataset, 4754 students from 39 different Bangladeshi universities participated in the survey. Thirteen key elements are selected as major attributes to analyze how AI tools affect students. Following data collection, we use a variety of preprocessing approaches to get ready for several advanced machine learning models. Next, we use a variety of models, such as Voting Classifier, Random Forest, Extra Trees Classifier, Bagging Classifier, Decision Tree Classifier, K-Neighbors Classifier and Support Vector Machines. Our processed dataset yields good results from the majority of the models, with Voting Classifier achieving the greatest accuracy (91.58%). The results show that ChatGPT greatly improves problem-solving, teamwork, and self-directed learning. However, issues with over-reliance on AI, data privacy, and its possible effects on creativity are brought to light. In order to responsibly integrate AI tools into education, educators and policymakers can benefit greatly from the insights this research offers. It emphasizes how crucial it is to strike a balance between traditional learning principles and technology breakthroughs in order to guarantee a sustainable, inclusive educational future in Bangladesh.

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Chapter 1

Introduction

This chapter explores the transformative impact of AI in education, focusing on ChatGPT's influence on Bangladeshi university students. It highlights how ChatGPT enhances personalized learning, self-study, and collaboration while addressing challenges such as ethics, dependency, and creativity. The chapter outlines the research aims, objectives, questions, and methodology, serving as a foundation for understanding the opportunities and challenges of integrating AI responsibly in education.

1.1 Introduction

Artificial intelligence (AI) is rapidly revolutionizing many aspects of our lives. In the field of education, artificial intelligence is revolutionizing the game. [1][2] One of these tools, ChatGPT created by OpenAI, is making headlines for being able to replicate human conversation, provide immediate responses, and help students with essay writing, researching, and problem solving. In recent months ChatGPT has become one of the most popular use of course and the extraordinary potential it holds in transforming the education system has already affected the teaching strategies and learning outcomes. It also questions its functionality in creativity, analytical thinking, and critical decision- making skills especially in developing countries like Bangladesh [3][4].

The use of AI-based tools such as ChatGPT in higher education in Bangladesh has evolved over time, facilitating self-study, peer learning, individual academic assistance, and even novel pedagogy. These tools make navigating problem solving and engagement in various disciplines more enriching. [5][6]. Nevertheless, the challenges posed by their adoption are excessive dependence on the technology, loss of creativity, and ethical issues around data privacy and algorithmic bias. [7][8]. In this regard, it is essential to balance the challenges with the opportunities that AI tools generate, to ensure their responsible, proper use within the learning context.[9] Addressing these concerns is still key to guaranteeing that the proactive enablement of classroom-embedded AI tools.

The study examines the roles ChatGPT plays solving academic problems, collaborative group study, individual self-directed learning, and how this new breed of technology is changing teaching itself in the context of relevant issues in Bangladesh. Survey data will be explored through analyses using machine learning algorithms including Voting Classifier, Random Forest, Extra Trees Classifier, Bagging Classifier, Decision Tree Classifier, K-Neighbors Classifier

and Support Vector Machines models by uncovering the associations between the use of AI tools like (chatgpt) and educational outcomes. Finally, the authors discuss ethical implications including privacy and bias in an effort to weigh the pros and cons of using AI in education.

This study intends to frame the opportunities and challenges that ChatGPT presents by considering the local context of Bangladesh. The results will guide educators, policymakers, and researchers to the best ways to use AI tools to benefit learning outcomes while taking ethical and other practical challenges into account. Different machine learning Voting Classifier, Random Forest, Extra Trees Classifier, Bagging Classifier, Decision Tree Classifier, K-Neighbors Classifier and Support Vector Machines. Data came from a survey of 1,370 students at 31 different universities. In comparison to other models, the Voting Classifier model has an accuracy rate of 91.58%, according to the data.

1.2 Motivation

AI integration in education is transforming learning by enhancing accessibility, engagement, and academic performance. Although these tools can enrich students' learning by providing individualized assistance, promoting self-directed learning and enhancing engagement, their widespread use also presents worries of dependency, loss of creativity and data privacy.

Bangladesh education is being technologically transformed, so, need to understand AI tools like chatGPT Answering questions like: "Do tools like ChatGPT enhance the learning experience?" ensuring ethics, addressing issues of data privacy, over-reliance, etc. In doing so this paper seeks to address the above knowledge-gap and through the application of machine-learning explore student responses and identify patterns relevant to ChatGPT usage in this setting. In doing so it aims to touch on best practices for educators, policymakers, and researchers on strategies for using AI for education while maintaining ethical principles and maximizing its advantages.

1.3 Objectives

The objectives of this study are designed to guide the exploration of the impact of AI tools, particularly ChatGPT, on Bangladeshi university students. These objectives are aligned with the research questions and aim to uncover both the benefits and challenges associated with integrating AI in education:

1.Examine how ChatGPT and other AI tools affect Bangladeshi university students' academic performance.

2. Provide insights to teachers, policymakers, and researchers about the responsible integration of AI tools in education.

1.4 Methodology

AI integration in education is transforming learning by enhancing accessibility, engagement, and academic performance. Although these tools can enrich students' learning by providing individualized assistance, promoting self-directed learning and enhancing engagement, their widespread use also presents worries of dependency, loss of creativity and data privacy.

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1.5 Project Outcome

The study shows the important role of AI tools, especially the ChatGPT to Bangladeshi higher education. Insights from 4,754 students across 39 universities reveal improvements in problem-solving, collaboration, and self-directed learning. The best accuracy was 91.58%, showing that the Voting Classifier model is an effective model for education outcome analysis. Despite the strengths of ChatGPT outlined in the study, challenges including data privacy, dependence on AI, and creative impact were among the findings. The results emphasize the need to integrate AI in responsible way that balances innovation and traditional learning values to maintain sustainable and inclusive education modern automation.

1.6 Organization of the Report

The report is divided into six chapters, each of which has been painstakingly written to add a distinct viewpoint to my main research story.

Chapter 1: Introduction
Chapter 2: Background
Chapter 3: Research Methodology
Chapter 4: Implementation and Results
Chapter 5: Engineering Standards and Design Challenges
Chapter 6: Conclusion
Reference
Plagiarism Report

Chapter 2

Background

2.1 Introduction

Social media is a digital platform that enables people to connect, share information and create all sorts of content. It is now very much indispensable in modern life and has had a considerable impact on individuals, society and businesses. Nevertheless, excessive or out of control usage has brought some problems such as addiction, mental health, productivity, and relationships. Machine learning is a kind of data-based decision-making method that can predict target based on data. So, we can use machine learning to predict the effect of people's lives on social media.

2.2 Literature Review

Tanvir et al.[12] examined the impact of ChatGPT on the academic performance of Bangladeshi undergraduate students, focusing on plagiarism, creativity, and motivation. Using a quantitative survey of 100 students, the study found interrelations between these factors, all influencing academic performance. The research highlights the need for institutions to mitigate over-reliance on ChatGPT and promote originality and innovation.The study is limited by its small sample size of 102 participants, restricting generalizability, and its reliance on self-reported survey data, which may introduce response bias. Future research should investigate ChatGPT's long-term impact on academic performance across diverse educational contexts to offer broader insights.

Hasan, N.A. et al.[13]: conducted a study analyzing the impact of AI, ChatGPT, and chatbots on education using machine learning algorithms. The study aimed to understand the benefits of ChatGPT, such as improved learning strategies and interactive lesson planning, and the drawbacks such as reduced creativity and over-reliance on AI. Data were collected offline from 2066 university students and analyzed using K-NN, NB, DT, RE, and SVM, with SVM 0.98 showing the best performance. An in-depth examination of the ethical impacts of ChatGPT on critical thinking and academic integrity is lacking. The limitation of the study is that a single-source data collection is used, which has a limited sample size of Bangladeshi university students, which may affect the generalizability of the results.

The study by Rahman, S et al. [14] examines university students' attitudes towards ChatGPT. The study analysed data from 344 students, revealing that

perceived usefulness, ease of use, and informativeness significantly influence their intention to use ChatGPT. Trust was found to be crucial in influencing enjoyment's effect on attitude. The study used Structural Equation Modelling (SEM), Technology Acceptance Model (TAM), and AMOS v23 software for data analysis and confirmed factor analysis. The study's limitations include a limited Bangladeshi university student sample and a focus on trust alone, suggesting potential future research on age and gender factors.

The study by Pavlenko, O., et al [15] explores Ukrainian students' experiences with ChatGPT as a learning tool. Surveying 247 students in Business, Engineering, and IT, it found high satisfaction across disciplines and a positive attitude towards ChatGPT improving learning quality. The study suggests educators incorporate generative AI into curricula and provide guidelines for effective use in academic and professional settings. The study's limitations include a small sample size of Ukrainian students from two institutions and the use of self-reported data, potentially introducing bias.

The study by Abdaljaleel, M, et al. [16] examined the factors influencing university students' attitudes and usage of ChatGPT in five Arab countries.Of the 2,240 participants, 52.6% had prior experience with ChatGPT prior to the study. The most significant determinants of an optimistic attitude were ease of use and social influence, followed by perceived usefulness and low anxiety. Attitudes were also significantly affected by university type, age and Country of residence as well as academic performance. The findings of the study validated the "TAME-ChatGPT" model for Chat-GPT adoption evaluation and highlighted that context-based policy making is required. Limitations of this study include convenience sampling, possible selection bias and its cross-sectional design makes it difficult to exclude any causality or observe changes over time.

The study by Iqbal et al [17]. explores the knowledge, attitude, and perception of ChatGPT among 145 faculty members and 855 students at ESPRIT Schools of Engineering and Business. It found that faculty had higher knowledge but a more reserved and negative attitude towards ChatGPT. However, over 40% of respondents trusted its reliability, despite concerns about its accuracy.Limitations of the study Targeted tunisian university student and teacher lack generalizability, The effect of two months since ChatGPT launch providing limited opportunity for non surface-level insights .

The study by Sandu et al. [18] Explores the impact of ChatGPT in Australian higher education, focusing on its role in teaching practice, student engagement and academic performance. Their study, involving 74 data analytics students, revealed that ChatGPT's tailored, on-demand support contributed significantly to academic improvement, explaining 17.3% of the variance in outcomes. ChatGPT's limitations include complex queries and its lack of human interaction. The findings emphasise the need for a strategic approach to integrating AI in education, with further research to expand its benefits and

effectively address these limitations.

The study by Naher et al. [19] surveyed 62 engineering students in Bangladesh, revealing that ChatGPT is commonly used for homework and test preparation, but students express concerns about accuracy and overreliance. The research emphasises the need for balanced use and suggests creating guidelines to support traditional learning methods, The study's small sample size and self-reported survey data may introduce response bias, necessitating future research to explore ChatGPT's impact on educational outcomes across different academic levels.

Singh et al.'s [20] study on 430 MSc computer science students at the University of Hertfordshire found that despite being familiar with ChatGPT, they rarely use it for academic purposes and are sceptical about its positive impact. They suggest that universities should provide clear guidelines for responsible use of ChatGPT, highlighting its potential benefits in education.The generalizability of the study is limited since it only includes MSc computer science students from a specific university and does not examine how prior familiarity with ChatGPT in participants affects learning outcomes. Future work can identify ways to best tailor the use of ChatGPT in education and help compare student performance based on useful tools.

The study by Vasudevan et al. [21] explores the perception of ChatGPT in higher education, highlighting its advantages and limitations. While ChatGPT aids instructors by providing content and online tutoring, it also poses challenges like inaccuracies, plagiarism risks, and AI "hallucinations." The study suggests that integrating ChatGPT requires updated policies and comprehensive training for students and teachers to ensure responsible and effective application.

A study by Urban et al.[22] found that ChatGPT improved creative problem-solving performance in university students by improving self-efficacy, solution quality, elaboration, and originality. However, it did not enhance interest in task resolution and students struggled to accurately self-evaluate their performance. The study suggests the need for effective metacognitive regulation when integrating AI tools in education, aligning with hybrid human-AI regulation (HHAIR) theory.

A study by Rathod et al.[23] found that ChatGPT improved creative problem-solving performance in university students by increasing self-efficacy, solution quality, elaboration, and originality. However, it did not enhance interest in task resolution and students struggled to accurately self-evaluate their performance. The study suggests the need for effective metacognitive regulation when integrating AI tools in education, aligning with hybrid human-AI regulation (HHAIR) theory. The study highlights the importance of metacognitive regulation in promoting teaching and learning.

A study by Pabreja et al [24]. analysed the satisfaction of undergraduate computer science students at a Delhi university using ChatGPT. The study used

data science research, including exploratory analytics, feature engineering, and predictive modelling, to evaluate the impact of ChatGPT on students' education, career, and social lives. The study found that the linear support vector classifier was the key factor in motivating satisfaction, with an accuracy score of 72.73% satisfied and 97.72% dissatisfied. The study suggests that ChatGPT has the potential to transform education and career development. However, the study's generalizability is low due to its focus on computer science students within a single university. Future research should explore the impact of ChatGPT in different contexts and its overall impact on student satisfaction and performance over time.Opara et al [25]. reviewed the prospects and challenges of ChatGPT in education, focusing on its applications in teaching, learning, and research. The study highlighted ChatGPT's strengths, such as rapid responses and conversational text generation, while noting limitations like a lack of citations and references. Recommendations include addressing these citation issues to enhance ChatGPT's educational utility. The study highlights ChatGPT's limitation in providing responses without proper citations or references, affecting its reliability for academic use. Future research should focus on improving ChatGPT's ability to generate responses with accurate citations and explore its integration into structured educational frameworks.

Hosseini et al. [26] explored the use of ChatGPT in education, research, and healthcare through a hybrid panel discussion and survey, receiving 420 responses. The study revealed varying levels of familiarity and interest, with more trainees than faculty having tried ChatGPT. Uncertainty about its acceptability in education was notable, alongside diverse perspectives on its pros and cons. The authors emphasised the need for careful consideration and further discussion to ensure responsible adoption of ChatGPT in these critical sectors. The study is limited by its reliance on a single panel discussion and survey with a modest response rate, which may not fully capture diverse perspectives on ChatGPT's use. Future research should explore broader populations and longitudinal effects to better understand ChatGPT's impact across education, healthcare, and research.

Ngo et al. [27] conducted a qualitative study on university students' perceptions of utilizing ChatGPT for learning, exploring its perceived affordances, affordance barriers and affordance workarounds. The survey gathered 200 responses through the online platform and 30 onsite interviews. The presentation showcased some features of ChatGPT such as time-saving, instant feedback, and writing clarity. Nonetheless, some hindrances were found such as reliability of the sources, citing properly and the use of language whereupon they refer to use of informal language. Other suggested solutions such as source check responses with trusted sources, utilising ChatGPT to obtain reference and citation, and ofcourse, advocating academic integrity. Sampling bias as a result of using a single socio demographic segment of university students and participant dependent factors, self reported data arise limitations of this study. Further

research should include diverse populations of students and longitudinal studies to see what kind of educational effect ChatGPT will have.

Table 2.1: Summary of Literature Reviewed

Author (s)	Year	Title	Methodology	Key Findings
Hasan, Nahid, et al [13].	2024	A novel approach to analyzing the impact of AI, ChatGPT, and chatbot on education using machine learning algorithms	Machine learning Algorithm Analysis	ChatGPT improves learning but its downside is a risk on creativity and analytical thinking, with SVM achieving 98% accuracy
Tanvir, K., Islam, el al, [12]	2023	Impact of ChatGPT on Academic Performance among Bangladeshi Undergraduate Students	Quantitative survey	ChatGPT affects academic performance by interlinking plagiarism, creativity, and motivation
Pavlenko, O al al, 2024 [15]	2024	Using Chatgpt as a Learning Tool A Study of Ukrainian Students'Perceptions	Quantitative Analysis	Ukrainian students reported high satisfaction with ChatGPT, citing its positive impact on learning quality across various disciplines
Abdaljale M et al [16]	2023	A multinational study on the factors influencing university students' attitudes and usage of ChatGPT	Quantitative Cross sectional survey analyzed	University students adopt ChatGPT due to ease of use, usefulness, positive tech attitudes, low risks, and demographic factors like age and academic performance.
Iqbal, et al [17]		Knowledge, Attitude, and Perception Towards ChatGPT Among University Students and Faculty: A Preliminary Exploration	quantitative analysis	Faculty knew more but were skeptical; students were positive yet wary of plagiarism. single-institution focus, short timeframe, and exclusive reliance on quantitative

2.3 Gap Analysis

The gaps discussed in this paper stem from a review of the literature, which identifies a lack of generalizability resulting from the use of region-specific small datasets, a lack of diversity, and a focus on only one type of assessment. Many studies, such as those by Hasan et al. [13] and Tanvir et al. [12], fail to explore long-term ethical and academic impacts, focusing instead on immediate benefits like enhanced learning strategies. In addition, ethical concerns like privacy, plagiarism and over-reliance on AI tools are also highlighted Rahman et al.[14] and Opara et al.[25] but have seldom been discussed in-depth regarding their long-term effects on academic integrity and critical thinking Chow et al. Most of the previous studies Sandu et al. [18] and Ngo et al [27], that use elementary statistical methods or use qualitative methods, hence fail to disentangle higher level casual relations from data.

This study overcomes these limitations by using machine learning algorithms on a dataset of 4754 university students from 39 universities in Bangladesh. It not only increases confidence in the insights regarding the impact of ChatGPT on education but also sets the stage for evidence-based solutions for the responsible adoption and implementation of AI in education.

2.4 Summary

This chapter looks at how AI tools like ChatGPT are changing education, focusing on their advantages and challenges. Past studies show that ChatGPT helps students with learning, self-study, and teamwork, but it also raises concerns about students becoming too dependent on it, losing creativity, and facing ethical issues.The analysis in Literature Review points out problems in previous research, like small datasets, narrow viewpoints, and not looking at long-term effects. To fix these issues, this study uses a larger dataset and advanced machine learning to better understand how ChatGPT affects university students in Bangladesh.

Chapter 3

Research Methodology

The research methodology employed to evaluate the impact of ChatGPT on education, detailing the systematic approach to data collection, preprocessing, and machine learning model implementation for insightful analysis

3.1.1 Overview

This Research analyzed the impact of ChatGPT on education using a dataset collected from 4,754 students across 39 Bangladeshi universities. After data collection, preprocessing steps were undertaken to prepare the dataset for machine learning analysis. String values in the dataset were converted into numeric representations to ensure compatibility with machine learning algorithms. The dataset was then divided into training and testing subsets to evaluate model performance. A range of machine learning algorithms was implemented to achieve the best results, including:

1. Voting Classifier
2. Random Forest Classifier
3. Bagging Classifier
4. Extra Trees Classifier
5. Decision Tree Classifier
6. K-Neighbors Classifier
7. Support Vector Classifier (SVC)

Among these, the Voting Classifier delivered the highest accuracy, achieving 91.58%. Each algorithm provided unique insights into the transformative role of AI tools like ChatGPT in education. The study also examined the potential challenges of AI integration, such as ethical considerations and over-reliance on technology.

3.1.2 Proposed Methodology/ System Design

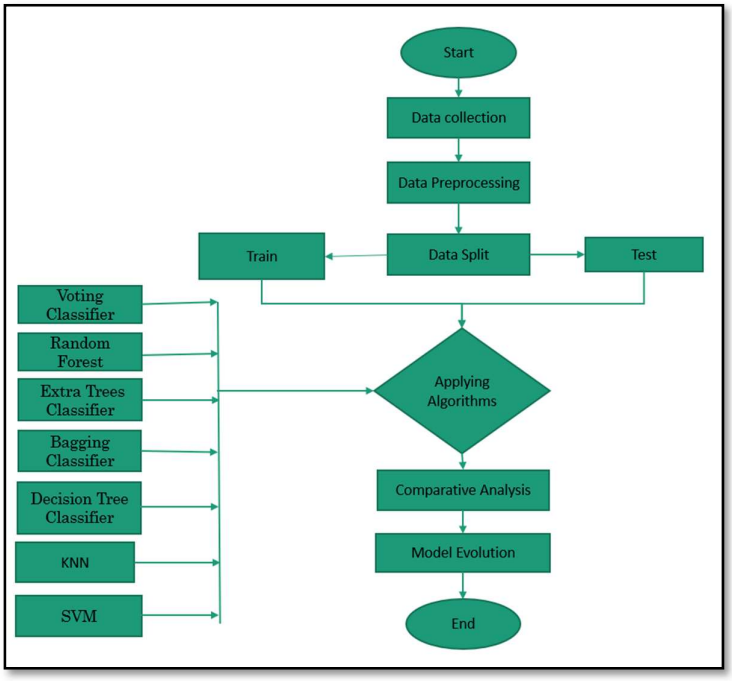


Figure 3.1: Execution Process

From my literature examination, I have deduced that certain classification algorithms exhibit notably higher accuracy than others. These algorithms include

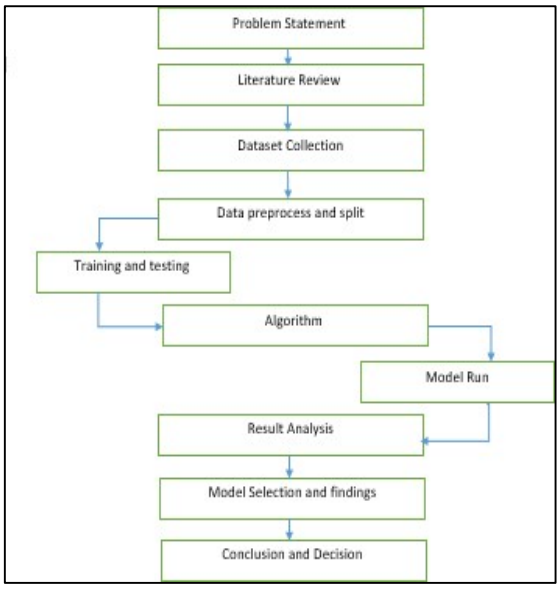


Figure 3.2 Data Flow Diagram Level

3.2 Detailed Methodology and Design

3.2.1 Dataset Description

Data was collected using a structured survey distributed through Google Forms, capturing responses from students over four weeks. Questions covered educational background, frequency of AI tool use, academic impact, and privacy concerns. Responses were analyzed to identify behavioral and perceptual patterns. Participation was voluntary, with informed consent ensuring ethical data collection.

This research aims to detect the impact of AI and ChatGPT on university students using machine learning. Our dataset questions are collected from previous research papers [11,13]. We collected data from 4754 students from 39 universities.

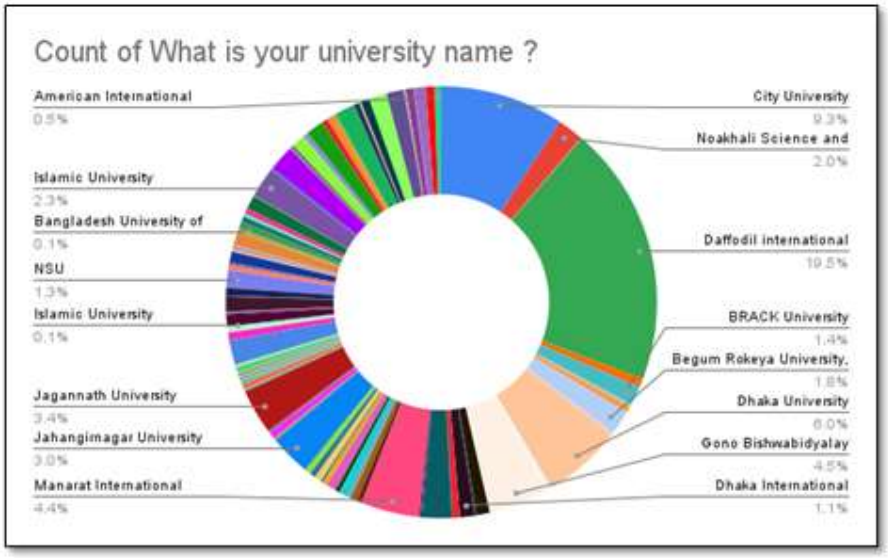


Fig 3.1: University Number name and Number pai chat

Table 3.1: RATIO AND NUMBER OF The impact of AI and ChatGPT on university students STUDENTS BASED ON DIFFERENT CATEGORIES.

Question	Option	RATIO	Number student
current level of education?	Undergraduate	79.45%	3659
	Postgraduate	20.55%	1095
Can AI tools like ChatGPT be utilized for academic purposes?	Daily	42.00%	1997
	Weekly	47.58%	2262
	Monthly	6.73%	320
	Never	3.68%	175
Has ChatGPT impacted the teaching	Significantly improved	43.29%	2058

methods in your courses?	Slightly improved	42.17%	2005
	Not sure	8.71%	414
	No impact	5.83%	277
Has ChatGPT influenced your approach to solving complex academic problems or assignments?	Yes	91.52%	4351
	No	5.03%	239
	Not Sure	3.45%	164
Do you use ChatGPT for group study or collaborative learning?	Yes	69.09%	3285
	No	11.30%	423
	Sometime	19.61%	932
Do you feel that AI assists you in self-paced learning?	Yes	88.76%	4219
	No	4.58%	218
	Not Sure	6.67%	317
Does ChatGPT help improve critical thinking and problem-solving?	Yes	86.67%	4119
	No	6.99%	332
	Not Sure	6.37%	303
Has ChatGPT provided useful guidance on your career path or educational choices?	Yes	65.6%	3117
	No	19.8%	940
	Not Sure	14.6%	694
How worried are you about the privacy and safety of your personal data when using AI tools like ChatGPT for academic tasks?	Worried	55.92%	2659
	Somewhat worried	31.72%	1508
	Not worried	12.36%	587
Do you think relying too much on AI tools like ChatGPT could harm students' creativity and critical thinking skills?	Strongly agree	52.27%	2485
	Agree	21.24%	1010
	Neutral	18.51%	880
	Disagree	5.32%	253
	Strongly disagree	2.67%	127
Do you believe using AI tools like ChatGPT reduces your creativity and critical thinking?	Yes	64.11%	3048
	No	7.76%	369
	Sometimes	28.12%	1337
Do you believe AI tools (like ChatGPT) improve your learning experience?	Yes	78.38%	3727
	No	5.41%	257
	Maybe	16.66%	770

The dataset was divided into two sets for evaluating model performance: training and testing. The data were split with 80% allocated for training and 20% for testing, as detailed in the table below

Table 3.1.2: Dataset Split Details

Dataset	Percentage	Number of Responses
Training	80%	3803
Testing	20%	951

3.2.2 Preprocessing

Data preprocessing is a crucial step in the machine learning workflow for preparing raw data for training machine learning models and ultimately helping us build a dependable, precise, and computationally savvy machine learning system.Two columns, Timestamp and University Name, were removed as their usage was not directly relevant to the analysis. This step ensures the dataset focuses solely on meaningful and impactful variables, enhancing the quality of the insights derived. A crucial step in this process was Label Encoding, where categorical variables were converted into numerical values using the LabelEncoder from the sklearn. preprocessing library. This transformation standardized the dataset by converting survey responses into integer values, enabling compatibility with machine learning models. The encoding process was applied uniformly across all columns in the dataset to maintain consistency.

Load Dataset

```
In [81]: data = pd.read_csv('The Impact of AI and ChatGPT on Bangladeshi Students_ A Machine Learning (12-11-2024).csv')
         data.head()
```

Out[81]:

	Timestamp	What is your university name ?	What is your current level of education?	How often do you use AI tools like ChatGPT for academic purposes?	How do you think ChatGPT has influenced teaching methods in your courses?	Has ChatGPT influenced your approach to solving complex academic problems or assignments ?	Do you use ChatGPT for group study or collaborative learning ?	Do you feel that AI assists you in self-paced learning ?	Does ChatGPT help improve critical thinking and problem-solving?	Has ChatGPT provided useful guidance on your career path or educational choices ?\n	How worried are you about the privacy and safety of your personal data when using AI tools like ChatGPT for academic tasks?	Do you think relying too much on AI tools like ChatGPT could harm students' creativity and critical thinking skills?	Do you believe using AI tools like ChatGPT reduces your creativity and critical thinking?
0	10/20/2024 16:53:32	Daffodil International University	Undergraduate	Daily	It has improved teaching methods significantly	Yes	Yes	Yes	Yes	Yes	Somewhat worried	Neutral	No
1	10/20/2024 17:06:27	Daffodil International University	Undergraduate	Monthly	It has improved teaching methods significantly	Yes	Sometime	Yes	Yes	Yes	Somewhat worried	Agree	Yes
2	10/20/2024 19:01:31	Daffodil International University	Undergraduate	Daily	It has improved teaching methods significantly	Yes	Yes	Yes	Yes	Yes	Not worried	Agree	Sometimes
3	10/20/2024 19:03:39	Daffodil International University	Undergraduate	Daily	It has improved teaching methods significantly	Yes	Yes	Yes	Yes	Yes	Not worried	Agree	Sometimes
4	10/20/2024 20:34:24	DIU	Undergraduate	Monthly	It has slightly improved teaching methods	Yes	Yes	Yes	Yes	Yes	Somewhat worried	Agree	Yes

Figure 3.2: Dataset before pre-processing.

Out[290]:

	What is your current level of education?	How often do you use AI tools like ChatGPT for academic purposes?	How do you think ChatGPT has influenced teaching methods in your courses?	Has ChatGPT influenced your approach to solving complex academic problems or assignments ?	Do you use ChatGPT for group study or collaborative learning ?	Do you feel that AI assists you in self-paced learning ?	Does ChatGPT help improve critical thinking and problem-solving?	Has ChatGPT provided useful guidance on your career path or educational choices ?\n	How worried are you about the privacy and safety of your personal data when using AI tools like ChatGPT for academic tasks?	Do you think relying too much on AI tools like ChatGPT could harm students' creativity and critical thinking skills?	Do you believe using AI tools like ChatGPT reduces your creativity and critical thinking?
0	1	0	2	2	2	2	2	2	1	2	0
1	1	1	2	2	1	2	2	2	1	0	2
2	1	0	2	2	2	2	2	2	0	0	1
3	1	0	2	2	2	2	2	2	0	0	1
4	1	1	3	2	2	2	2	2	1	0	2
...	...	...	...	...	...	...	...	...	...	...	...
4749	1	1	2	2	1	2	2	2	1	2	1
4750	1	3	3	2	2	2	2	2	1	2	2
4751	1	1	2	2	2	2	2	2	1	3	2
4752	1	0	2	2	2	2	2	2	0	3	2
4753	1	3	2	2	1	2	2	1	1	3	0

4754 rows × 11 columns

Figure 3.2 : Dataset after pre-processing

3.2.3 Model Description

A classifier is a machine learning algorithm designed to assign class labels to data inputs based on specific features. In this study, three types of classifiers were used to analyze the dataset. The experiment comprises of seven different machine learning model Random Forest, Bagging Classifier, Extra Trees Classifier, support vector machines(SVM), K-nearest Neighbors (KNN), Decision Tree Classifier and Voting Classifier that classify the dataset and examine patterns on the dataset in this study. Utilizing complex mathematical and statistical techniques, these algorithms predict the likelihood of data falling into specific categories. As classifiers are important in supervised learning, they reveal patterns and relationships found in the data How ChatGPT affects the academic performance or learning behaviors as well as critical thinking.

Table 3.2.3 : Model Description

Number	Type Name	Classifier
T1	Instance based	K-Nearest Neighbors (K-NN), Support Vector Machine (SVM)
T2	Tree-based	Random Forest Classifier, Bagging Classifier, Extra Trees Classifier, Decision Tree Classifier
T3	Ensemble-based	Voting Classifier

3.2.3.1 Random Forest

Random Forest (RF) is based on bagging, which is one of the most famous and common machine learning algorithms where a multitude of decision trees are constructed during training time and the output is combined in unison to enrich the accuracy and stability. The method is particularly beneficial for classification and regression tasks [21].

$$error\ (Mi\ ) = \sum wj\ d\ j = 1\ \times\ err(\ Xj) \ldots\ldots\ldots (1)$$

3.2.3.2 Extra Trees Classifier

Extra Trees Classifier is an ensemble of learning that has its roots in decision tree learning. Extra-Trees Classifier is used for classification problems because of its great strength. This model is further bolstered by the Gorilla Troops Optimizer (GTO) and Reptile Search Algorithm (RSA), as are modern techniques used for optimizing decisions and increasing the accuracy of predictions [29]. These improvements allow the model to search for parameters spaces extensively and effectively in order to get the best parameter tuning. Thus, it outperforms a host of traditional tree-based classifiers across the varying dataset.

$$\hat{y} = \text{mode}(T_1(x), T_2(x) \ldots\ldots T_M(x)) \ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{Impurity}(S) = -\sum_{i=1}^{C} P_i \log(P_i) \ldots\ldots\ldots\ldots (3)$$

$$\Delta I = I(S) - \left(\frac{|S_L|}{|S|} I(S_L) + \frac{|S_R|}{|S|} I(S_R)\right) \ldots\ldots\ldots\ldots\ldots (4)$$

3.2.3.3 Support Vector Machine (SVM)

SVM An supervised deep learning method used in AI and ML systems for data labelling. supervised learning for classification and regression.[11] It can be defined mathematically as:

$$B = |A| cos\theta \times |B| \ldots\ldots\ldots\ldots\ldots (5)$$

3.2.3.4 K-Nearest Neighbors (K-NN)

The K-NN classifier uses geometric distance to select the five closest neighbors, determining the distance of a query to all samples, and choosing the Kclosest instances. This process aids in efficient categorization by focusing on local neighborhood information, contributing to patterns research and grouping by neighboring data properties. [21]

$$\left(\sum_{i=1}^{k} (|x_i - y_i|)^q\right)^{\frac{1}{q}} \ldots\ldots\ldots\ldots\ldots (6)$$

3.2.3.5 Decision Tree Classifier

The Decision Tree Classifier is a non-parametric machine learning algorithm that utilizes a tree-like structure to make decisions based on input features. In this study, it has been effectively employed to classify students based on their use of ChatGPT and its impact on their academic performance, learning

behaviors, and critical thinking skills.

Equation for Decision Tree:

Entropy: $H(S) = -\sum_{i=0}^{n} Pi\ log_2$(p…… (7)

Information Gain: $IG(S, A) = H(S) - \sum_{U \epsilon VALUES}^{n} \frac{S}{V} H(S_V)$ … … (8)

Gini Index: $GS = 1 - \sum_{i=1}^{n} P_i^2$ … …. . (9)

3.2.3.5.1 Bagging Classifier:

Bagging (Bootstrap Aggregating) is an ensemble learning technique that improves the stability and accuracy of machine learning algorithms by combining the predictions of multiple base models (often decision trees). Each model is trained on a different random subset (with replacement) of the dataset. The final prediction is made by averaging the predictions (for regression) or taking a majority vote for classification.
Bagging Classifier Formula for Classification:

$$H(x) = mode\{h_1(x), h_2(x), \ldots \ldots \ldots, hk(x)\} \ldots \ldots 10$$

3.2.3.5.2 Voting Classifier

Voting classifiers are a federated learning technique that combines predictions from multiple machine learning models to make a final decision. By combining the output of different models, voting classifiers increase the accuracy of predictions and reduce the risk of overfitting. In my implementation, the classifier employs strict voting, where each individual model votes for a class and the class with the majority vote is selected as the final prediction. Weights are also assigned to each model to reflect their relative importance in the match.

In our research, the Voting Classifier is built using the following models:

- Random Forest Classifier
- Extra Trees Classifier
- Decision Tree Classifier
- Bagging Classifier

Mathematical Equation:
Hard Voting (Majority Rule with Weights):

$$H(x) = arg\ max_c \sum_{i=1}^{M} wi.1(h_i(x) = c) \ldots \ldots \ldots 11$$

3.2.4 Performance Matrix

3.2.4.1 Confusion Matrix

Confusion matrix is one of several evaluation metrics that measure the performance of classification models. The classification report is a crucial metric for assessing model performance in machine learning. Unlike relying solely on accuracy scores to determine the optimal model for a given dataset, the classification report delves into various factors contributing to performance evaluation. The report includes the following key elements:

Table 3.2.4.1: Confusion matrix format

	[Predicted negative]	**[Predicted negative]**
[Actual negative]	True Negative - Predicted false, actual was false	False Positive - Predicted true, actualwas false
[Actual positive]	False Negative - Predicted false,actual was true	True Positive- Predicted true, actualwas true

3.2.4.2 Accuracy

Accuracy gauges the proportion of correctly predicted samples from the overall dataset. The accuracy formula follows: The accuracy is expressed as follows in equation (11).

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}} \dots\dots\dots\dots\dots (11)$$

3.2.4.3 Precision

Precision signifies the ratio of True Positive results to all Positive predictions, often called positive predictive value. The precision formula is given by [11]

$$\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}} \dots\dots\dots\dots\dots\dots (12)$$

3.2.4.4 Recall

Also known as sensitivity or true positive rate, recall is the ratio between the number of accurate predictions and true positive results. The recall formula is expressed as(11).

$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}} \dots\dots\dots\dots\dots (13)$$

3.2.4.5 F1-Score

The F1-Score combines precision and recall into a single metric to evaluate the overall effectiveness of a classification model, particularly in cases with an imbalanced dataset. It is the harmonic mean of precision and recall, giving equal weight to both metrics. (11).

$$\text{F1} - \text{Score} = \frac{2 * \text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \dots\dots\dots\dots (14)$$

3.3 Summary

This chapter explained the workflow of the study, including data collection, data pre-processing, and machine learning model implementation. Research data were collected from 4,754 students at 39 universities by structured surveys, and pre-processed through steps such as encoding. The data set was divided into two different sets for training and testing the performance. Different classification algorithms were applied such as Voting Classifier, Random Forest, Bagging Classifier etc out of which Voting Classifier gave best accuracy equal to 91.58%. This systematic approach consists of a coherent framework of how to implement ChatGPT influence on education, while also dealing with insights like ethics and dependency on AI tools.

Chapter 4
Implementation and Results

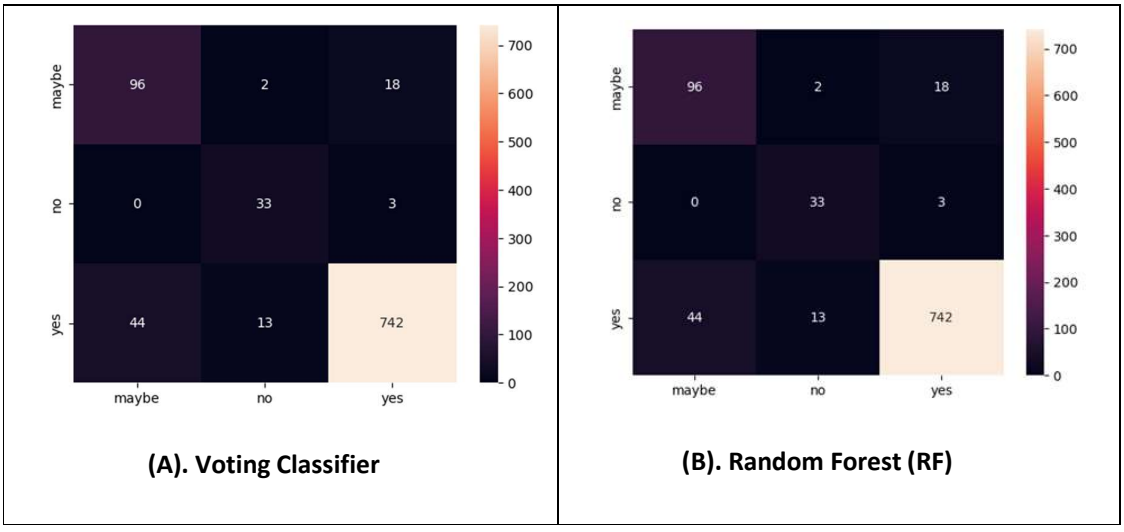
This chapter provides a comparative evaluation of various machine learning classifiers, focusing on their accuracy and performance metrics. It highlights the strengths of ensemble methods like Voting Classifier and Random Forest.

4.1 Environment Setup

For this study, experiments were conducted using Google Colab and Jupyter Notebook, leveraging their robust capabilities for data processing, model training, and analysis. A computer with a stable internet connection was utilized to ensure seamless execution of machine learning tasks and efficient dataset handling. The dataset, stored in .csv format, was processed and analyzed using Python libraries in these platforms, enabling effective experimentation and result visualization.

4.2 Testing and Evaluation/Performance/ Comparative Analysis

4.2.1 Confusion matrix



(A). Voting Classifier

(B). Random Forest (RF)

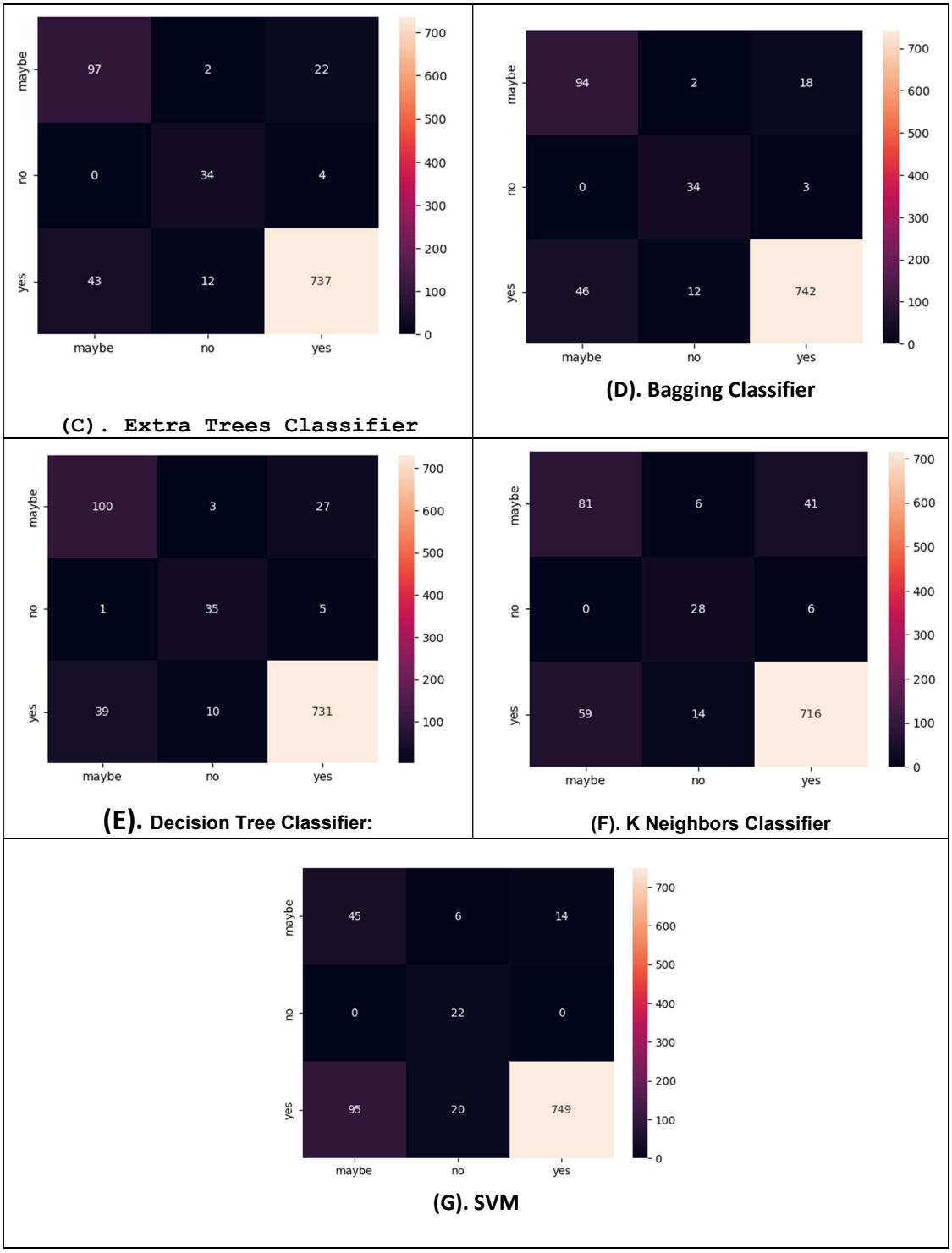


Fig. 4.1.2. Confusion matrix of (A) Voting Classifier, (B) Random Forest (C) Extra Trees Classifier, (D) Bagging Classifier, (E) Decision Tree Classifier, (F). K Neighbors Classifier, (G) SVM

Fig. 4.1.2: Comparing Classifier Performances Using Confusion Matrices. This section looks at how seven different models Voting Classifier, Random Forest (RF), Extra Trees Classifier, Bagging Classifier, Decision Tree Classifier, and K-Nearest Neighbors (KNN) , Support Vector Machine (SVM) svm performed. The confusion matrices show how well each model predicted the correct class and where they made mistakes.

The Voting Classifier (A) worked the best overall. For Class 0, it only made 18 mistakes 2 predicted as Class 1 and 16 as Class 2. Class 1 had 6 errors 2 predicted as Class 0 and 4 as Class 2, while Class 2 was mostly accurate, with 44 errors 13 as Class 0 and 31 as Class 1. This shows that the Voting Classifier is very reliable for predictions.

The Random Forest (B) was also very good, with similar performance to the Voting Classifier. For Class 0, it made 19 errors 2 as Class 1 and 17 as Class 2. For Class 1, it had 6 mistakes 3 as Class 0 and 3 as Class 2. Class 2 was also accurate, with 44 errors 13 as Class 0 and 31 as Class 1.

The Extra Trees Classifier (C) performed nearly as well as Random Forest. It made 22 mistakes in Class 0 2 as Class 1 and 20 as Class 2 and only 4 mistakes in Class 1 all as Class 2. For Class 2, it had 43 errors 12 as Class 0 and 31 as Class 1, showing it is another strong model.

The Bagging Classifier (D) was good but made slightly more errors than the Voting and Random Forest models. For Class 0, it had 18 mistakes 2 as Class 1 and 16 as Class 2. Class 1 had 7 errors 3 as Class 0 and 4 as Class 2, and Class 2 had 46 errors 12 as Class 0 and 34 as Class 1.

The Decision Tree Classifier (E) didn't perform as well as the ensemble models. Class 0 had 27 mistakes 3 as Class 1 and 24 as Class 2. For Class 1, there were 5 errors 1 as Class 0 and 4 as Class 2, while Class 2 had 39 mistakes 10 as Class 0 and 29 as Class 1. This shows that single decision trees might not work as well as groups of models.

The K-Nearest Neighbors (KNN) Classifier (F) struggled the most. For Class 0, it made 41 errors 6 as Class 1 and 35 as Class 2. Class 1 was not very accurate, with 6 errors all predicted as Class 2. Class 2 had 59 mistakes 14 as Class 0 and 45 as Class 1. This shows KNN has trouble when the data isn't evenly distributed.

The Support Vector Machine (SVM) Classifier (G) displayed a mixed performance. For Class 0, it made 20 errors 6 as Class 1 and 14 as Class 2. Class 1 achieved excellent accuracy, with no misclassifications. Class 2 showed a strong performance with 115 mistakes 95 as Class 0 and 20 as Class 1. While SVM demonstrates potential, it struggles with larger class imbalances in Class 2.

In conclusion, the ensemble methods like Voting Classifier, Random Forest, and Extra Trees performed the best, with the Voting Classifier leading the way. These methods combine the strengths of multiple models, which helps make better predictions. On the other hand, KNN had the most problems, especially in Class 0. This comparison shows that using multiple models together (ensemble methods) is often the best approach.

4.3 Results and Discussion

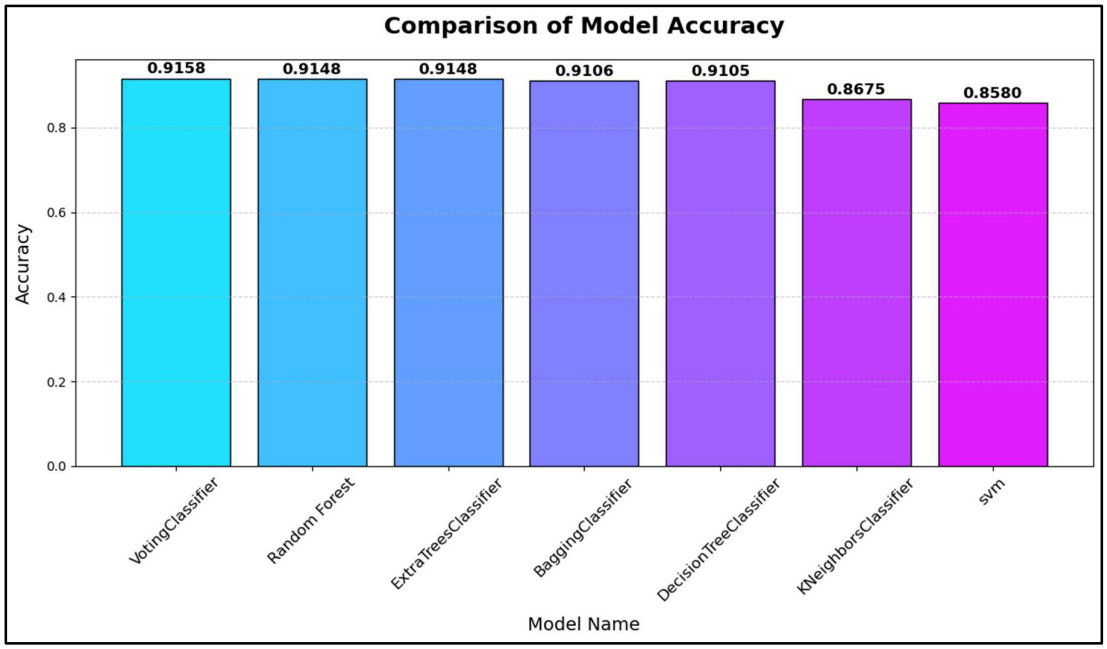


Fig 4.3.1 Comparison of Model Accuracy

The Fig 4.3.1 show Comparison of Model Accuracy illustrates the performance of various machine learning classifiers based on their accuracy. The Voting Classifier achieves the highest accuracy of 91.15%, followed by Random Forest 91.14%, Extra Trees Classifier 91.14%, and Bagging Classifier 91.06%. Other models, such as the Decision Tree Classifier 91.05%, K-Neighbors Classifier 86.75%, and Support Vector Classifier SVC 85.80%, also perform well but fall slightly behind.

These results better highlight how powerful is use of combination of methods like voting classifiers and random forests on educational analytic datasets in this case. These insights, in turn, confirm the modeling decision that led to the dependable predictions made in research.

4.3.1 Classification Report

Table 4.3.1: Classification Report

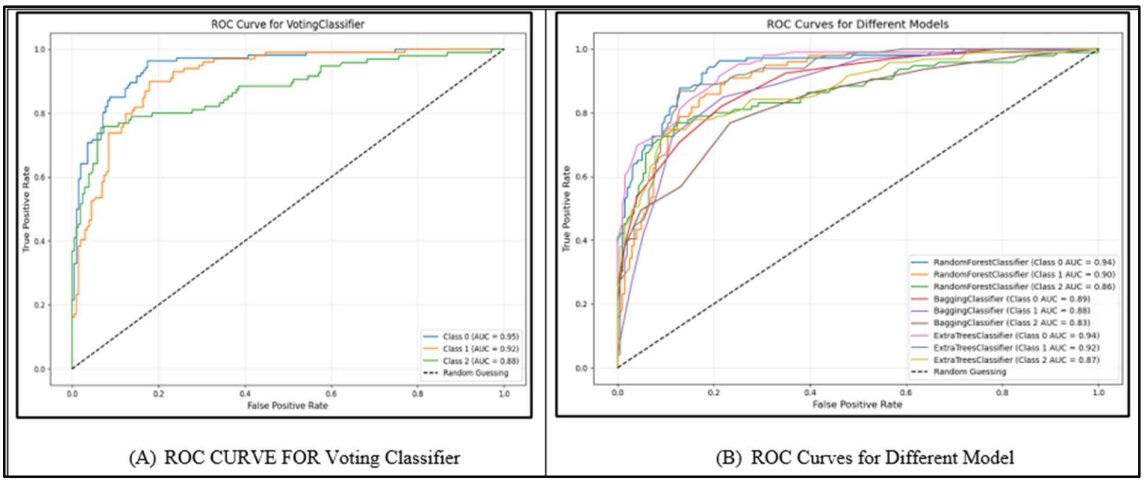
Model Name	Accuracy	Precision	Recall	F1 Score
Voting Classifier	0.9158	0.93	0.91	0.92
Random Forest Classifier	0.9148	0.93	0.91	0.92

Extra Trees Classifier	0.9148	0.92	0.91	0.92
Bagging Classifier	0.9106	0.93	0.91	0.91
Decision Tree Classifier	0.0.9105	0.93	0.91	0.91
K-Nearest Neighbors	0.86.75	0.88	0.87	0.87
Support Vector Machine	0.8580	0.92	0.86	0.88

The classification report in Table 4.3.1 provides an overview of the performance of the different machine learning models that were employed in the research. The Voting Classifier demonstrated its strong predictive abilities by achieving the greatest accuracy 91.58% with outstanding precision, recall, and F1 scores 0.93, 0.91, and 0.92, respectively. Comparable metrics also demonstrated the remarkable performance of Random Forest and Extra Trees Classifiers, demonstrating the power of ensemble approaches in managing intricate datasets.

The Bagging Classifier and Decision Tree Classifier also demonstrated solid performance, achieving accuracy slightly above 91% while maintaining consistent precision and recall values. However, the K-Nearest Neighbors (KNN) classifier showed lower accuracy 86.75%, reflecting challenges in handling imbalanced data. The Support Vector Machine (SVM) achieved the lowest accuracy of 85.80% but maintained a respectable precision of 0.92, despite facing challenges with recall.

Overall, the results show that ensemble methods, especially voting classifiers, perform exceptionally well in providing reliable and accurate predictions for educational data analysis. These methods effectively combine the strengths of multiple models, making them a powerful tool for achieving consistent and precise results. them a powerful tool for achieving consistent and precise results.



(A) ROC CURVE FOR Voting Classifier (B) ROC Curves for Different Model

4.3.2 ROC curve of the algorithms

Fig 4.3.2: The figure compares the performance of different machine learning models using ROC (Receiver Operating Characteristic) curves. In part (A), the ROC curve for the Voting Classifier shows its strong ability to classify data accurately, with high AUC (Area Under the Curve) values: 0.95 for Class 0, 0.93 for Class 1, and 0.88 for Class 2. These high scores indicate that the Voting Classifier performs very well, especially for Class 0 and Class 1. In part (B) shows the ROC curves for different machine learning models, such as the Random Forest Classifier, Bagging Classifier, and Extra Trees Classifier. The AUC values measure how well each model can distinguish between classes. For instance, the Random Forest Classifier achieves AUC scores of 0.94 for Class 0, 0.90 for Class 1, and 0.86 for Class 2, indicating strong performance. Similarly, the Bagging Classifier and Extra Trees Classifier also perform well with competitive AUC values. Models with curves closer to the top-left corner are more accurate. Overall, the Voting Classifier and Random Forest stand out as the best models for accurate predictions in this dataset.

4.4 Summary

This chapter evaluated seven machine learning classifiers: Voting Classifier, Random Forest, Extra Trees Classifier, Bagging Classifier, Decision Tree Classifier, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM). The analysis showed that ensemble methods, particularly the Voting Classifier 91.58% accuracy and Random Forest 91.48% accuracy, outperformed individual classifiers in accuracy, precision, recall, and F1-score.

Ensemble methods proved effective in handling class imbalances and minimizing misclassifications. In contrast, the SVM 85.80% accuracy struggled with smaller classes, highlighting its limitations. This comparison underscores the superiority of ensemble techniques for achieving reliable predictions, particularly in domains like educational analytics.

Chapter 5

Engineering Standards and Design Challenges

5.1 Compliance with the Standards

Communication standards are critical in ensuring that data and information are effectively exchanged throughout this research. For our study, Google Forms was employed as a primary tool for collecting survey responses, ensuring seamless communication with participants. The survey was designed to be clear, concise, and accessible across devices, fostering high response rates. Additionally, platforms like Google Colab and Jupyter Notebook facilitated efficient collaboration and streamlined data processing and analysis. These tools, coupled with proper documentation practices, ensured transparency and consistency in research communication, both within the team and with external stakeholders.

5.2 Impact on Society, Environment and Sustainability

The study of depression among Bangladeshi university students has significant ramifications for the welfare of society. The knowledge and understanding gained from this research help the academic community become more mindful of mental health issues. The research has a significant impact on how society views mental health by bringing attention to the incidence and effects of depression.

The emphasis significantly impacts social norms around conversations about mental health on lowering stigma and encouraging candid communication. This change helps build a more understanding and encouraging society, where people are encouraged to ask for assistance without worrying about being judged. Long-term effects include fostering a culture that prioritizes mental health, enhancing interpersonal relationships, community dynamics, and the resilience of society as a whole.

5.2.1 Impact on Life

The integration of AI tools like ChatGPT into education has significantly influenced students' academic and personal lives. It has enhanced learning efficiency by providing instant access to information, enabling personalized learning experiences, and fostering self-directed study habits. Students have reported improvements in problem-solving skills, collaboration, and academic performance. However, concerns such as over-reliance on AI and potential impacts on creativity and critical thinking highlight the need for balanced integration. This dual impact underscores the

transformative role of AI in shaping not only educational outcomes but also lifelong learning and adaptability in an increasingly digital world.

5.2.2 Impact on Society & Environment

The widespread adoption of AI tools like ChatGPT has profound implications for society and the environment. On a societal level, these tools democratize access to quality education by bridging gaps in resources and enabling personalized learning for diverse populations. They foster innovation in teaching methods and promote collaborative learning, contributing to a more inclusive educational ecosystem.

However, environmental concerns arise from the energy-intensive nature of training and deploying AI models, which rely heavily on computational power and data centers. The carbon footprint associated with these technologies emphasizes the need for sustainable AI practices. Striking a balance between the societal benefits and environmental costs is crucial to ensuring that AI adoption in education remains both impactful and responsible.

5.2.3 Ethical Aspects

This study addresses critical ethical considerations associated with the integration of AI tools like ChatGPT in education. Data privacy and confidentiality were prioritized by anonymizing the data of 4,754 students from 39 universities and ensuring secure storage. Transparency is emphasized to prevent over-reliance and misinformation, encouraging students and educators to understand AI's limitations. The risk of algorithmic bias is acknowledged, with a call for regular monitoring and updates to ensure fairness. Additionally, concerns about over-reliance on AI impacting creativity and critical thinking are highlighted, stressing the need for balanced usage guidelines. Finally, the study underscores the importance of equitable access to AI tools while addressing issues like plagiarism through robust academic policies, ensuring ethical and sustainable integration of AI in education.

5.3 Project Management and Financial Analysis

Table 5.3: Project Financial Analysis

Category	Description	Estimated Cost (BDT)
Data Collection	Survey tools	5000-8500
Hardware Resource	Laptops, Storage devices	30000-32000
Learning Resources	Paper writing course	2500-3000
Other	Other	1000-1500
Total		38500-45000

5.4 Complex Engineering Problem

5.4.1 Complex Problem Solving

In this section, provide a mapping with problem solving categories. For each mapping add subsections to put rationale (Use Table 5.1). For P1, you need to put another mapping with Knowledge profile and rational thereof.

Table 5.1: Mapping with complex problem solving.

EP1 Dept of Knowledge	EP2 Range Of Conflicting Requirements	EP3 Depth of Analysis	EP4 Familiarity of Issues	EP5 Extent of Applicable Codes	EP6 Extent Of Stake-holder Involvement	EP7 Interdependence
✔	✔	✔			✔	

EP1: Depth of Knowledge

Rationale: This study looks at how AI tools like ChatGPT impact education by using advanced machine learning methods. To do this, I need a solid understanding of AI, how to prepare and analyze data, and how these technologies work in educational settings.

EP2: Range of Conflicting Requirements

Rationale: In this research, we need to balance different conflicting requirements. For example, we must protect data privacy while still allowing detailed analysis. We also aim to promote the use of AI tools without making people too dependent on them. These challenges need to be carefully managed to avoid ethical issues and practical problems.

EP3: Depth of Analysis

In this study, I use several machine learning models to compare their performance and understand their impact on education. By analyzing these models in detail, I can draw strong conclusions about how effective AI tools like ChatGPT are and what they mean for education.

EP6: Extent of Stakeholder Involvement

This study includes input from important stakeholders like students, teachers, and policymakers. Their feedback is essential to understand how AI can be practically used in education and to make sure the research focuses on real-world issues and concerns.

Mapping with Knowledge Profile for EP1

This table 5.2) is designed to map the EP1 to the Knowledge Profile.

Table 5.2: Mapping with knowledge Profile.

K3 Engineering Fundamentals	K4 Specialist Knowledge	K5 Engineering Design	K6 Engineering Practice	K8 Research Literature
✔	✔			✔

K3: Engineering Fundamentals

This point relates to how we used basic machine learning concepts to analyze how AI tools like ChatGPT are affecting students. We applied these fundamental ideas to understand and measure the changes in education brought by AI.

K4: Specialist Knowledge

In this study, I used specialized knowledge, like advanced AI techniques and data analysis. This expertise was important to properly evaluate how ChatGPT impacts education and to understand the data I collected from students.

K8: Research Literature

At this point, we relied on previous studies and research papers to conduct our work. To strengthen our project we reviewed what previous researchers have revealed about AI in education. This was essential for gaining an understanding of the knowledge landscape, identifying gaps and ensuring that our work was a novel contribution. This literature also helped us understand how we should organize our analysis and how we should define our results.

5.4.2 Engineering Activities

In this part of the project , our goal was to explore other tools and techniques to help us conduct our research. To process our data and run machine learning models, we utilized tools such as Google Colab, Jupyter Notebook. In addition to that we collaborated with students, educators, and policymakers to obtain valuable insights and ensure our findings relevant. We also explored the societal impact of our work such as how we can leverage it to improve education while also being cognizant of issues including data ownership and ethics. These technical instruments, along with the practical partnership, yielded productive outcomes.

Table 5.3: Mapping with complex engineering activities.

EA1 Range of re-sources	EA2 Level of Interaction	EA3 Innovation	EA4 Consequences for society and environment	EA5 Familiarity
✓	✓		✓	

EA1: Range of Resources

This point reflects how we used various tools and resources such as Google Colab and Jupyter Notebook for data processing and analysis. These resources were crucial for processing large datasets and implementing machine learning models.

EA2: Level of Interaction

Our project involves collaboration with students, academics, and policymakers. This interaction has helped us gather valuable insights and ensured that our findings are relevant and practically applicable.

EA4: Consequences for Society and Environment

We explored the broad implications of AI tools like ChatGPT for education and society. This includes understanding both positive changes, such as improved learning experiences, and potential challenges, such as data privacy concerns and overreliance on technology.

5.1 Summary

This chapter illustrates how the project adheres to complex engineering standards by addressing multifaceted challenges, mapping them to knowledge profiles, and aligning them with professional activities. It highlights the innovative use of AI tools and machine learning to solve real-world educational problems while considering ethical, societal, and environmental implication.

Chapter 6

Conclusion

ChatGPT is a conversational chatbot that has massive amounts of data trained over a pre-learned application. It is truly an invention that changes the world. ChatGPT is a revolutionary AI-powered conversational chatbot with a vast reservoir of pre-learned application data, revolutionizing the education sector. This groundbreaking invention, equipped with a vast amount of previously learned data, is a game-changer in the field. Our study travels across this ground-breaking territory. This study underscores the transformative impact of AI tools, particularly ChatGPT, in enhancing education for Bangladeshi university students. The study also underscores ChatGPT's capabilities in promoting self-directed learning, collaborative studying, and academic problem solving, based on machine learning models analyzing data from 4754 students. Out of the models used, Voting Classifier outperformed, achieving an impressive 91.58% accuracy in recognizing patterns and outcomes associated with ChatGPT usage. To tackle challenges like the impact on data privacy or creativity, the study emphasizes the search for a form of balance between more technology in education and the more traditional learning methods and values.

The implications of this study for researchers, educators and policymakers are numerous, as it outlines the importance of ethical methods of AI, steps to protect privacy and strategies to spur independent thought and creativity. The development and integration of tools like ChatGPT in the ed-tech arena will require consistent evaluation and adjustment to ensure that we are maximizing their benefits while correcting their disadvantages, thus paving the way for a richer and more fruitful educational experience.

6.1 Summary

Artificial intelligence has completely digitalized modern education. Numerous cutting-edge AI tools, including ChatGPT and generative AI, are having an impact on our schooling. This study presents a scenario of how Chat GPT and AI affect Bangladeshi students' critical thinking and learning habits in the context of higher education. Using a qualitative survey form, we attempt to create an exclusive dataset. In order to create this dataset, 4754 students from 39 different Bangladeshi universities participated in the survey. Thirteen key elements are selected as major attributes to analyze how AI tools affect students. Following data collection, we use a variety of preprocessing approaches to get ready for several advanced machine learning models. Next, we use a variety of models, such as Voting Classifier, Random Forest, Extra Trees Classifier, Bagging Classifier, Decision Tree Classifier, K-Neighbors Classifier and Support Vector Machines. Our processed dataset yields good results from the majority of the models, with Voting Classifier achieving the greatest accuracy (91.58%). The results show that ChatGPT greatly improves problem-solving, teamwork, and self-directed learning. However, issues with over-reliance on AI, data privacy, and its possible effects on creativity are brought to light. In order to responsibly integrate AI tools into education, educators and policymakers can benefit greatly from the insights this research offers. It emphasizes how crucial

it is to strike a balance between traditional learning principles and technology breakthroughs in order to guarantee a sustainable, inclusive educational future in Bangladesh.

6.2 Limitation

While this study provides valuable insights into the impact of AI tools like ChatGPT on Bangladeshi students, several limitations must be acknowledged. The sample primarily consists of undergraduate student data, with limited representation from postgraduate students due to challenges in data collection. Additionally, the study includes data from only 39 universities, which may not fully represent all institutions across Bangladesh, particularly given variations in technological infrastructure between urban and rural areas. The focus on ChatGPT may not generalize to other AI tools, and the findings, specific to Bangladeshi higher education, may not apply universally. Ethical and privacy challenges, along with the rapidly evolving nature of AI, further underscore the need for periodic updates. Recognizing these limitations highlights areas for future research to address these gaps and enhance the understanding of AI's role in education.The implications of this study for researchers, educators and policymakers are numerous, as it outlines the importance of ethical methods of AI, steps to protect privacy and strategies to spur independent thought and creativity. The development and integration of tools like ChatGPT in the ed-tech arena will require consistent evaluation and adjustment to ensure that we are maximizing their benefits while correcting their disadvantages, thus paving the way for a richer and more fruitful educational experience.

6.3 Future Work

Future research can address the limitations of this study by incorporating a more balanced dataset that includes postgraduate students and a larger number of universities across Bangladesh. Expanding the scope to include additional attributes, such as long-term learning impacts and diverse AI tools beyond ChatGPT, will provide deeper insights. Additionally, ongoing research is needed to address emerging ethical, privacy, and technological challenges as AI continues to evolve in higher education.

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