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Assessing the Level of Using Machine Learning Approaches in Higher Educational Institutions of Bangladesh: A Study of Three Science and Technology Universities

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Abstract

This study aimed at assessing the current state of machine learning (ML) adoption in Bangladesh's higher education system. A survey among 162 respondents revealed that 55% of students find ML techniques unsatisfactory, with major challenges such as lack of skilled manpower, budget constraints, high AI costs, and government support. However, 68.4% of students believe ML presents an opportunity, while 26.5% do not. To address these challenges, the study proposes three recommendations: organizing seminars, securing funding, and procuring technology. By investing in skilled manpower, resources, and technology, Bangladesh can become better prepared for ML-driven digital learning and unlock the full potential of AI and ML in the education sector. Future research should focus on evaluating the effectiveness of proposed solutions and exploring additional strategies to ensure successful integration of ML techniques in higher education, ultimately leading to improved teaching and learning outcomes.

Keywords: Machine learning, Higher education, Bangladesh, and Challenges

1. Introduction

Bangladesh has made significant progress towards digitization while mainly depending on its agro-based economy. Almost every area of life has changed as a result of industrialization, automation, and innovation (Fahmida, 2021). At the heart of these developments is the use of machines to replace manual methods to everyday issues. Machine learning is a crucial element of Bangladesh's Fourth Industrial Revolution (4IR) standards, which are being pursued (Shibli, 2022). By utilising techniques from mathematics, statistics, and computer science, the "artificial intelligence" (AI) component of machine learning (ML) automates the biological

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learning process in humans. By using layers of artificial neurons to abstract the underlying issue and generate ground-breaking findings in numerous domains, Deep Learning (DL), a novel subject, enables ML. From an academic and teaching-learning standpoint, the higher education (HE) sector is a challenge domain for employing DL to address open questions (Hannan et al., 2021). In order to address unresolved challenges from an academic and teaching-learning perspective, DL is being used in the higher education (HE) sector (Hannan et al., 2021). Particularly in higher education, where data mining, pattern recognition, and predictive analysis are utilised to understand problems with learning systems, ML is swiftly gaining ground. These approaches support the creation of initially impractical solutions. As a result, ML is thought to be the HE sector's most leveraged component (Bates, T. et al., 2020). As a developing country, Bangladesh must overcome a number of challenges in order to include ML into its higher education system.

Teachers are the front line in higher education, as they are in all levels of education. Digital tools and software can drastically change how traditional classroom instruction is delivered. The lack of training in data-driven analytical skills, research-oriented data interpretation, ML resource management, perspectives on human-machine interaction, and the use of robots to perform repetitive tasks are just a few of the difficulties teachers and instructors face in adjusting to this change (Rahman, M., 2022). Additionally, explaining modern technical breakthroughs to students might be difficult.

Machine learning (ML) has a substantial impact on Bangladesh's higher education system, providing chances for improvements in virtual teaching assistants, individualised tutoring programmes, and intelligent educational content. Deep learning chatbots can perform as virtual professors, analyse domain-specific data, and offer individualised tutoring services on online learning platforms like Coursera, edX, and Udacity.

1.1 Statement of the problem

With a total population of 160 million and a population density of 962 persons per square kilometre, Bangladesh, a country in South Asia, is one of the most densely inhabited nations in the world. According to UNICEF 2010 data, adult literacy now stands at 54% and primary school enrollment is at 81%. The government is working to develop inclusive education and achieve universal education.

Building on its digitization initiatives from the previous decade, Bangladesh has used artificial intelligence (AI) as a catalyst to facilitate the nation's digital transformation. According to the Honorable Prime Minister Sheikh Hasina, the government plans to introduce 5G by 2023, along with the rapid integration of big data, block chain technology, artificial intelligence, robots, and the Internet of Things. Given that AI is seen as a crucial technology that will influence the future, this AI strategy document serves as a model for the nation's upcoming technological advancement.

Nevertheless, with over 163 million residents, including over 40 million students, living in a 147,570 km2 territory, Bangladesh has serious job issues. The main concern is the potential loss of employment prospects brought on by the introduction of AI, which could eventually

supplant human abilities. In 2021, nations with high population densities like Bangladesh, where the majority of talent is low-level, should pay particular attention to this issue. The World Economic Forum predicts that robotics and artificial intelligence will likely create more jobs than they destroy. With an estimated 133 million new jobs forecast to be generated by the Fourth Industrial Revolution, adoption of AI and related technologies is anticipated to boost economic growth and offer a myriad of new job opportunities.

The prediction is not wholly rosy, though, as 75 million jobs may be lost by 2022, according to estimates. Retraining the populace in the proper skills is necessary for a smooth transition to the new period of the fourth industrial revolution. Graduates from higher education must work to create the capital infrastructure of the future and change Bangladesh's labor-intensive manufacturing strategy into knowledge-intensive ecosystems.

1.2 Rationale of the study

Significant discussions have been sparked by the quick development of technology and the ensuing disparities in learning possibilities. Big data and AI in particular have seen the exponential expansion of technical developments, which has led to the creation of a new paradigm and novel learning environment. For instance, the Nokia 1100 was a popular mobile phone in 2002, 20 years ago. Nevertheless, 75% of people in sub-Saharan Africa use cell phones that are many generations more modern (GSMA Intelligence, 2020). The COVID-19 pandemic has made it clear that the hurdles to entry are changing from technical needs to the willingness and need for adoption. To allow for the creation of tools and the improvement of abilities, higher education (HE) systems must incorporate machine learning (ML). In teaching-learning activities, a thorough ML system will assist in bridging the gap between teachers and students. Additionally, it will give teachers the ability to automate time-consuming administrative tasks and enhance student outcomes. Early exposure to technology will improve students' preparation for the job market because they will need to access ML-driven employment markets in the future.

The teacher-to-student ratio in Bangladesh is approximately 1:30, which makes it difficult to provide individualized instruction depending on each student's needs (Staff correspondent, 2021). However, recent technical developments have demonstrated that a machine learning (ML)-based intelligent education system is capable of efficiently delivering lectures, grading exams, and giving feedback. Experience-based education has long been promoted by problem-based learning methodologies (Hmelo-Silver, C. E., 2004). A customized curriculum can be imagined as the future of higher education with the aid of ML.

Numerous ML educational uses have been made possible by the ongoing technology revolution, and the list keeps expanding. A thorough demographic analysis of such intelligent systems might help us better comprehend their application, spot problems, and find solutions. The results of this study is help to understand the extent to which machine learning is useful in the community, motivate the early adoption of machine intelligence (artificial intelligence and machine learning) as well as deep learning in Bangladesh's higher education system, and serve as a resource for the future.

1.3 Objectives of the study

The objectives of the research are:

1. To assess the level of using machine learning techniques in higher education institutions,
2. To investigate the existing barriers to applying ML to the HE system, and
3. To discover the challenges of using ML approaches in the university

1.4 Review of literature

Significant discussions have been sparked by the quick development of technology and the ensuing disparities in learning possibilities. Big data and AI in particular have seen the exponential expansion of technical developments, which has led to the creation of a new paradigm and novel learning environment. For instance, the Nokia 1100 was a popular mobile phone in 2002, 20 years ago. Nevertheless, 75% of people in sub-Saharan Africa use cell phones that are many generations more modern (GSMA Intelligence, 2020). The COVID-19 pandemic has made it clear that the hurdles to entry are changing from technical needs to the willingness and need for adoption. To allow for the creation of tools and the improvement of abilities, higher education (HE) systems must incorporate machine learning (ML). In teaching-learning activities, a thorough ML system will assist in bridging the gap between teachers and students. Additionally, it will give teachers the ability to automate time-consuming administrative tasks and enhance student outcomes. Early exposure to technology will improve students' preparation for the job market because they will need to access ML-driven employment markets in the future.

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On the other hand, online education is insufficient, according to the authors of (Mollah, A. H., and Parvin, 2020), to replace conventional classroom instruction in Bangladesh's higher education system. This is because practical exams, lab tests, field trips, and other HE activities

are required. Additionally, their research suggests that online education might be advantageous in emergency situations like the COVID pandemic. Long-term online education does, however, confront obstacles like a lack of ICT gadgets, inconsistent Internet connectivity, and health issues related to extended computer and smartphone use. The obstacles of online education, including the roles of institutions and governments, the digital divide, and public perception, were examined in another paper (Chowdhury, M. K., & Behak, F. B. P. (2022)).

For online teaching-learning, however, it is possible to address issues like the government's digitization strategy, the lack of seats in public universities, session backlog reduction, and permitting concurrent work and study. The authors of (Ehsan, S., 2021) explored the potential effects of AI on the future RMG business and advised that academic institutions should modify their course curricula accordingly. In another study (Hossin, M. S., et al., 2021), the authors looked at how HRM may be used to boost Bangladesh's industry. They discovered that integrating AI into HE courses could increase students' employability. Virtual reality (VR), augmented reality (AR), mobile platforms, and other technologies may be used to create an engaging learning environment without the requirement for an instructor's direct physical help (Khan, H. et al., 2021). The authors of this study created a system that enables students to learn in an immersive environment using AR and VR technologies. It can be accessed through a web interface even with inexpensive equipment. The authors claim that the method can assist students in comprehending complex subjects, and that because it doesn't rely on tutors, it is a cost-effective educational option. The literature makes it obvious that Bangladesh is transitioning towards a digital education system, so it is important to assess the performance of our HEI now and in the future. Therefore, before carrying out a sizable survey in the future, a pilot study in a controlled setting (like a science and technology university) is required.

Conceptual framework

The presented conceptual framework Table 4 provides an overview of the study's focal point: students' difficulties when utilizing machine learning in higher education institutions. The data collected through primary data collection methods, such as the survey questionnaire and face-to-face interviews, serve as inputs. The activities undertaken include descriptive and inferential

Table 1 Structure of conceptual framework

Problems	Inputs	Activities	Outputs	Outcomes	Impact
Limited use of machine learning in higher education	Primary data from respondents, Semi-structured questionnaire, Face-to-face interview	Gathering and analyzing data on machine learning use in higher education	Identification of current state and issues in machine learning implementation, Suggestions for improvement	Enhanced use of machine learning in higher education, Improved learning outcomes, increased institutional efficiency, Facilitated research environment	Advancement of the education system, Positive impact on society and economy

statistical analyses to determine the mean, mode, median, standard deviation, and frequencies of various variables that describe and characterize the population. The study's outputs comprise various visual aids, including graphs, tables, figures, and charts generated for analysis. The study's outcomes entail identifying diverse ways machine learning can enhance personalized learning, facilitate skill acquisition, foster collaborative learning environments, facilitate data sharing and storage, improve institutional efficiency, and provide researchers with an accessible research environment. Ultimately, the study aims to contribute to developing effective strategies for integrating machine learning in higher education institutions, which would enhance the quality of education and improve students' skills. There are specific concepts identified in this study. These concepts have been explained briefly in Table 4 and also here to provide a clear conception of this study.

Methodology

The study's methodology is covered in detail in this section, with an emphasis on the research methods used, sample approaches, data gathering tools, data collection processes, and data analysis processes.

3.1 Study areas

The study is focus on Computer Science and Engineering (CSE) and Statistics departments in three distinct science and technology universities: Noakhali Science and Technology, Sylhet Shahjalal Science and Technology, and Bangabandhu Sheikh Mujibur Rahman Science and Technology. The present study is based on primary data, which are obtained from participants who serve as the data source. The nature of the study follows qualitative approach.

3.2 Sampling

Table 2 outlines the sampling frame of the study.

Table 2 Data sampling frame

Selected University	Selected Department	Questionnaire distributed	Responded questionnaire	Finally selected	Percentage (%)
Noakhali Science and Technology	CSE	50	33	29	58
	Statistics	50	35	31	62
Shahjalal Science and Technology	CSE	50	27	22	44
	Statistics	50	26	20	40
Bangabandhu Sheikh Mujibur Rahman Science and Technology	CSE	50	32	30	60
	Statistics	50	28	24	58
Total		300	181	156	53.67

Two students were selected from each department at the universities chosen to participate in the study. However, two incomplete questionnaires resulted in a final sample of 10 respondents. Additionally, the heads of departments from six departments across the three universities were chosen to participate in the study.

Table 3 The demographic profiles of the valid respondents (current students)

Characteristics		Frequency	Percentage
Gender	Male	96	61.53
	Female	60	38.47
Age	21 to 23 years	88	56.41
	24 to 26 years	53	33.97
	26 years above	15	9.62
Level of study	Undergraduate final year	91	58.33
	Graduate	65	41.67

Table 3 presents the demographic characteristics of the valid respondents (N=156) asymmetrically distributed across gender, age, and level of study. Of the respondents, 96 (61.53%) were male, and 60 (38.47%) were female. The majority of participants, 56.41% (n=88), were between the ages of 21 and 23 years, while 33.97% (n=53) were between 24 and 26 years, and a minority of 9.62% (n=15) were 26 years and above. Concerning the level of study, approximately 58.33% (n=91) of participants were in their final (4th) year of undergraduate study, and 41.67% (n=65) were enrolled in graduate programs.

3.3 Data collection method

To give a complete picture of how machine learning is used in higher education institutions, especially in science, a number of factors are taken into account. Face-to-face interviews were used to administer semi-structured questionnaires to acquire primary data. To gather the data and verify its accuracy, a field supervisor and a data collector were hired. In order to confirm its validity, one data collector double-checks the questionnaire of another data collector.

3.4 Data analysis

Determining the mean, mode, median, and frequency of numerous variables describing and characterizing the population were the main goals of the descriptive statistical study. For analysis, pertinent graphs, tables, figures, and charts were produced. For the sake of inferential statistics, SPSS software was used to process ordinal data on respondents' opinions and viewpoints. The following tests and strategies were part of the inferential statistical plan.

3.6 Ethical consideration

The investigation adhered to the updated standards of the Helsinki Declaration. It was explained to respondents what the purpose of the study was, how it would be conducted, how long it would take them to participate, and how the findings would be used, including how they would be disseminated. This information was also included in the informed consent form. Respondents received guarantees that the information they provided would remain anonymous and that the research findings would always be presented as a whole rather than separately. The safety of the responders came before the project's objectives for the researchers.

Findings and discussion

The goal of the current study is to assess how widely machine learning methods are used in Bangladesh's higher education institutions. This section includes an examination of the demographic details of the study subjects, who offered significant context for the application of machine learning techniques.

4.1 Current student opinion regarding the current state of using machine learning techniques

Table 4 Student views of the current state of using machine learning techniques

Item	Never (%)	Rarely (%)	Undecided (%)	Sometimes (%)	Often (%)	Average score	Results
Did you ever implement any Machine learning techniques?	43	40	7	1	9	1.60	Rarely
Use of classification techniques	12.5	40.3	8.5	21.3	17.4	1.73	Rarely
Use of various regression techniques.	3.8	18.8	5.6	32	40	3.14	Sometimes
The usability of the decision Tree technique	40	35	12	5	8	1.48	Never
Have you ever used machine learning approaches to improve learning in higher education?	4.5	15.5	40	25	15	1.61	Rarely

According to Table 4, 40% of the students rarely use machine learning approaches. Around 42% of the students never implemented any machine learning approaches. While only 9% of students often use it. So, we may conclude that students do not frequently use different machine learning techniques. The table also depicts that almost 40% of the respondents rarely use some or any of the classification techniques.

On the other hand, just 17% of students often use different classification approaches, which is a low percentage. While 12.5% of the respondents never use any classification techniques. The result reflects that students lack proper knowledge about the usability of classification techniques. The study shows that nearly 40% of the respondents sometimes use some or all of the regression techniques. On the other hand, almost 32% of students consistently use different regression approaches, which is not so bad.

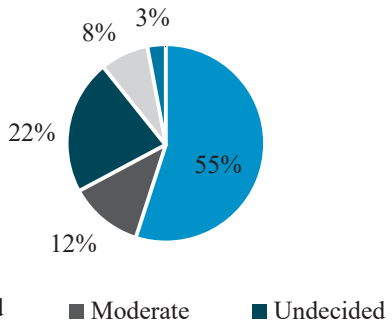
On the other hand, 3.8% and 18.8 % of the students, respectively, use it rarely or never. So, we may conclude that students have average knowledge about the usability of regression techniques. But it should be increased.

According to the above table, nearly 40% of the students never use the decision tree techniques. And around 35% of them rarely use decision trees. Whereas only 5% of the respondents sometimes use it. Nearly only 8% of the students often use decision trees. We may infer that the respondents have a scarcity of knowledge about decision trees' applicability.

The utilization of machine learning approaches to improve learning in higher education is demonstrated in the table above. Almost 40% of the respondents are undecided about this statement, and about 40% said they had used machine learning techniques. In contrast, a substantial portion of respondents, nearly 20%, never or rarely used it. The findings thus suggest that we should enhance its usability.

4.2 Student's view regarding the present status of machine learning techniques used in the department

Figure 1 Respondent views regarding the present status of machine learning techniques used in the department



Above pie chart shows that in response to the question about the present status of using the machine learning (ML) approach, almost 55% replied that this situation is terrible. In comparison, nearly 12% said moderate,which means not so good, and negligible noted that the statement is good or excellent. Overall, the scenario is worst in the university, so it should be increased with proper guidelines.

4.3 Alumni views regarding the current state of using machine learning techniques

Based on Table 5, it can be inferred that a significant percentage of alumni have limited or no experience with machine learning techniques. The data shows that 50% of alumni rarely

used machine learning approaches, and 29% never implemented them. Only 8% of alumni reported using machine learning approaches often. Therefore, it can be concluded that most alumni lack familiarity with machine learning techniques. The table also depicts that almost 50% of the respondents rarely use some or any of the classification techniques.

On the other hand, just 25% of students sometimes use different classification approaches, which is a low percentage. While 10% of the respondents never use any classification techniques. The result reflects that students lack proper knowledge about the usability of classification techniques. The study shows that nearly 40% of the respondents sometimes use some or all of the regressions.

Table 5 Alumni views the current state of using machine learning techniques

Item	Never (%)	Rarely (%)	Undecided (%)	Sometimes (%)	Often (%)	Average score	Results
Did you ever implement any Machine learning techniques?	29	50.5	10.5	2	8	1.23	Never
Use of classification techniques	10.4	50	12.5	25.6	11.5	1.82	Rarely
Use of various regression techniques.	2.5	15.5	12	40	30	3.56	Often
The usability of the decision Tree technique	48.5	30	10	8.5	3	1.39	Never
Have you ever used machine learning approaches to improve learning in higher education?	1.5	28.5	12	43	15	3.1	Sometimes

techniques. On the other hand, almost 30% of alumni consistently used different regression approaches, which was not so bad. On the other hand, 2.5% and 15.5 % of the students, respectively, use it rarely or never. So, we may conclude that alumni have average knowledge about the usability of regression techniques. But it should be increased. According to the above table, nearly 48% of the alumni never used the decision tree techniques. And around 30% of them rarely use decision trees. Where only 8.5% of the respondents sometimes use it. Nearly only 3% of the alumni often use decision trees, which is very low. We may infer that the respondents have a scarcity of knowledge about decision trees' applicability.

The utilization of machine learning approaches to improve learning in higher education is demonstrated in the table above. Almost 58% of the respondents said they had used machine

learning techniques. In contrast, a substantial portion of respondents, nearly 30%, never or rarely used it. The findings thus suggest that we should enhance its usability.

4.4 Respondent views regarding the familiarity of the ML approach

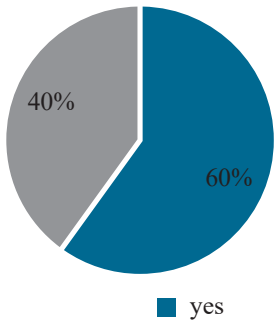
Table 6 Familiarity with the ML approach

Respondents	Rarely	Often	Almost	Regular
Students	18.8	42.5	29.1	8.8
Alumni	39.5	35.5	11.5	12.5

As shown in Table 6, the finding outlines that close to 42.5% of the students are often familiar with machine learning approaches. And around 29% of them are familiar with it. And only 18.8% of the respondents are rarely aware of it. Almost 9% of the students are consistently familiar with it. We may infer that the respondents have an extensive understanding of machine-learning approaches.

4.5 AI and ML have an Impact on your job

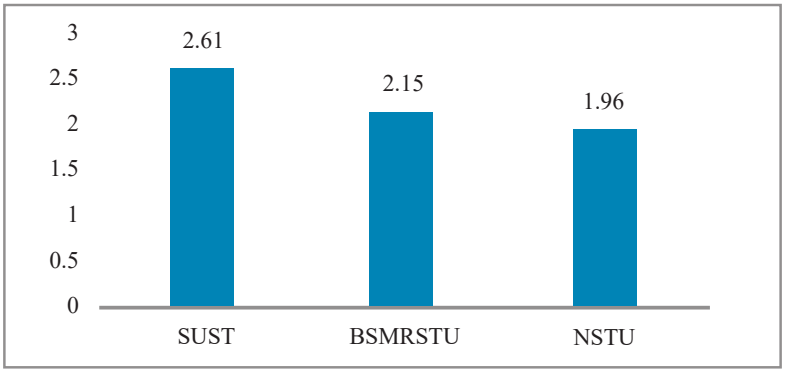
Figure 2 AI and ML have impact on jobs



The pie chart in Figure 2 shows that 60% of alumni think ML and AI impact their jobs. This means that ML significantly affects advancement opportunities, better compensation, less expected job stress, and job satisfaction.

4.6 Comparative Score of three selected university on the level of usability of ML approach

Figure 3 Comparative score of the different universities on the level of usability of the ML approach



The respondent overall scores for the usability of the ML approach are respectively 2.61, 2.15, and 1.96, which respondents rarely use on the issues that ML techniques do not adequately address in these universities. Therefore, using ML techniques in these universities is inadequate on the rating scale.

Conclusions

The development of machine learning (ML) methodology has the potential to enhance student teaching and learning outcomes in various industries, including education. However, the use of ML in higher education is not sufficient in Bangladesh's higher education sector, with only 55% of current students stating that the techniques are lousy. The majority are undecided about the situation, with only 4% of students believing machine learning presents an opportunity and 26.5% not. Nearly 55% of respondents use ML-based technologies for academic purposes, while 39.7% are unsure about their benefits.

Most students are comfortable with digital education, with 48% comfortable with digital education, while 7% are not comfortable with the concept. The main challenges faced in implementing AI and ML in universities include lack of skilled manpower and insufficient budget. The high cost of AI solutions and lack of government support contribute to these challenges.

Alumni respondents believe that AI and ML impact their job, with skilled graduates having more employment opportunities than unskilled graduates. Most respondents believe that the lack of AI and ML education is the primary cause of job dissatisfaction. Despite these challenges, a survey conducted among stakeholders from three science and technology universities revealed that 55% of respondents use ML-based technologies for academic purposes, while 39.7% are unsure about their usefulness.

Recommendation

- The Government can take the initiative to ensure the availability of infrastructural resources for the Institutions. Both government and universities should take proper steps to create more positive awareness and benefits of AI and ML to their stakeholders.
- Skilled manpower and insufficient budget raises,
- Workshop, training, and seminars for teachers should be increased,
- Increasing the budget for this education sector can resolve matters and help create more skilled manpower through training and development,
- Conduction of an adequate awareness program is necessary to educate faculty, and students especially science background to remove the perception gap of AI and ML based services.
- Collaboration with other researchers and industry.

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