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Effects of co-curricular activities on student's academic performance by machine learning

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ABSTRACT

The study project named "Effects of Co-Curricular Activities on Student's Academic Performance Through Machine Learning" examines the effect of co-curricular activities on a student's academic performance. The purpose of this study is to determine the relationship between extracurricular activities and student performance. Co-curricular activities are extracurricular activities that support and enhance the academic or core curriculum. They are a vital component of educational institutions' attempts to help students develop their personalities and improve classroom learning. However, a significant proportion of pupils in Bangladesh do not participate in such activities. One of the primary reasons is because many believe these activities would jeopardize a student's academic performance. This study's objective is to ascertain the actual effect of co-curricular activities on pupils. It was discovered that there is a positive correlation between co-curricular activities and academic performance using Logistic Regression using Python and Google Colab.

1. Introduction

Co-curricular activities benefit students by providing opportunities to apply their knowledge and skills, develop new abilities and interests, and strengthen their social and organizational skills. Students may acquire practical expertise by taking part in co-curricular activities related to their topic. Additionally, it is said that participation in such activities provides pupils with a competitive advantage on their resumes. However, not all pupils in Bangladesh participate in co-curricular activities. Many of them and their guardians think that engaging in such activities would negatively affect their academic achievement. As a result, students are often perplexed about whether or not to participate in extracurricular activities. Thus, the authors of this research-based initiative want to dispel that ambiguity. The writers of this research-based initiative will attempt to determine why kids are not participating in co-curricular activities. What might be the possible explanations for this, and if they are accurate. The writers will attempt to determine the specific advantages that students get from engaging in extracurricular activities. Finally, the authors will try to draw a link between academic achievement and the extracurricular activities of students. Each year, student performance in academics and placements deteriorates, and this trend must be examined to improve student performance in future batches. Academic and co-curricular accomplishments are the sole determinants of students' placement performance (Ramalingam and Ilakkiya, 2021). The purpose of this research was to ascertain graduates' self-reported involvement in and attitudes toward a range of embedded, extracurricular, and co-curricular learning activities, as well as paid employment, that promote employability. A plethora of embedded, co-curricular, and extracurricular activities have developed to increase employability (Jackson and Bridgstock, 2021). The purpose of this study is to predict EQ among college students (ages 19 to 21) by considering all of the significant factors that affect their EQ either directly or indirectly (Desai et al., 2021). The purpose of this research is to describe a novel and unique method and function utilized by AI for teaching, as well as an outcome-based teaching-learning process using educational technology and its statistical result analysis using the T-test (Gonge et al., 2021). This study examined the psychological effects of participation in a residential research-oriented learning community on students' interest and motivation to pursue research-oriented careers, self-efficacy beliefs in research and data, sense of community belonging, socialization levels, and career awareness in research-oriented sectors (Magana et al., 2021).

2. Literature review

Ananya Singh's study article sought to determine the overall impact of co-curricular activities on students' academic achievement and personal development. And the outcome is favorable. This study report demonstrated how co-curricular activities enhance students' academic

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pursuits. It revealed that females participate in co-curricular activities at a greater rate than boys. Additionally, it is shown that females are obtaining better grades in all subjects (Singh, 2017). Chi-Hung, Chi Wing Raymond Ng, and Po On Ella Chan completed a research paper titled "Can Co-curricular Activities Improve Students' Learning Effectiveness?: An Application to Sub-degree Students in Hong Kong" to determine if co-curricular activities can improve students' learning effectiveness and if they have a positive effect on students' academic performance. However, they discovered that co-curricular activities had little impact on students' learning efficiency (Chi-Hung and Chan, 2011). Ahmad, Rahman, Ali M, Rahman, and Al-Azad conducted a study paper to ascertain the students' involvement in co-curricular activities and academic performance at a specific medical institution. Males excelled in outdoor sports and photography groups, while girls excelled at indoor sports, debate, and other cultural activities (Ahmad et al., 2019). According to their study, 205 female students engage in indoor activities, compared to 105 male students. It was discovered that pupils who engaged in extracurricular activities outperformed those who did not. Additionally, they developed abilities such as collaboration and leadership. Moon et al. proposed a technique for detecting video using natural language processing. Natural language processing has received considerable interest in recent years as a new multidisciplinary area. (Moon et al., 2021)

Salehin et al. proposed using artificial intelligence and LSTM techniques to develop an easily accessible rainfall prediction model. For this technique of implementation, the deep learning methodology is critical, as is its accuracy. They included six variables in their article. Analyzing all data resulted in a 76% accuracy. Salehin et al. (2020) proposed a model RHMCD that aids in achieving the intended goal via the use of machine learning techniques. The following methods were evaluated: Naive Bayes classifiers, logistic regression, and the Support Vector Machine. The method of sentiment analysis was utilized to elicit reports of mental illnesses. Depression was quantified using a decision tree method. Salehin et al. (2021) predicted the depression level associated with heavy cell phone usage. To identify depression, two machine learning algorithms are used: decision trees and linear regression. Salehin et al. (2020) developed agricultural technology. Numerous influenza, fungal, and bacterial diseases result in a significant loss of agricultural goods. In this paper, they utilize the Scale-Invariant Transform Feature (SIFT) method to identify crop conditions using several datasets. Finally, the solution was implemented via SMS and live online portals (I. Salehin et al., 2020). Talha et al. emphasize the significant harmful side effect and their many origins, including emotional imbalance, sadness, tension, and loneliness. The data was gathered in three ways: physically, virtually, and via medical reports. The Naive Bayes 71 percent optimistic theorem demonstrates the detrimental impact of human behavior. They provide an unfavorable and a positive parameter for measurement in SVM. Finally, they correlate the effects of our suggested specialization and the three fundamental points of reference outcomes. (Talha et al., 2020) Shetu et al. study aim to develop an algorithm that can identify the Bangladesh style from a given Bangladesh paragraph input in Sadhu or Cholito Bhasha. It contributes to the discovery of the Goruchondali Dosh, a prevalent grammatical mistake in written Bangladeshi, demonstrating that many investigative studies aim to detect flaws in Bangladeshi grammar. In contrast, other linguistics scholars follow a consistent pattern. (S.F. Shetu et al., 2020) Shetu et al. used educational data mining to forecast students' performance. The full forecast was predicated on the individual's academic standing and the academic environment in which they are located. (S.F. Shetu et al., 2020) Hosen et al. developed a method for playing music and changing the screen wallpaper in real-time video streams based on emotional detection of facial expressions. To extract various face characteristics, they utilized a camera to create their dataset based on facial expressions, using Haar classifiers. Then we build an emotional and user-interest-based playlist, as well as a model of the changing wallpaper, so that we may listen to music that suits our emotions and change our desktop wallpaper to more cheerful pictures when we are unhappy. (Hosen et al., 2019).

For wireless networks, Ullah et al. developed the Adjacent Collaborative MAC Protocol (ACDM), a new directional MAC protocol. The objective is to improve the efficiency of the drive and delay while also reducing the total wireless network footprint. (Ullah et al., 2015). Sarker et al. categorized physician conduct in medical records. They conducted the study using data mining (Sarker et al., 2011). Moon et al. developed the recognition method using the Bangla 'Banjonborno' and 'Sorborno' characters. The characters are scanned and transformed to a m x n matrix, then scaled down to 16 × 16 using the Matlab restart scaling function before being sent to the multilayer Neural Network. The feedforward algorithm is monitored using the supervised technique of learning. This well-known system can recognize characters of any size with an accuracy of more than 74% (Moon and Sarker, 2011).

3. Methodology

3.1. Data collection procedure

To get information from pupils, the writers created a questionnaire with pertinent questions to get the desired findings. The writers then created a Google form and shared it with current pupils. 850 students participated in this study by completing a google form provided with them by the authors.

3.2. Data pre-processing

Data preparation is how data is processed before being used by the writers to get the result. This is a critical stage in the data mining process. Typically, a verdant dataset is unsuitable for algorithm execution. Raw datasets are incapable of producing anticipated outcomes. It is difficult for a machine to read. That is why data preparation is a machine; after a dataset has been preprocessed, it may be interpreted by algorithms or engines. The data set includes 850 entries with missing values. The Authors used mean imputation to fill in the missing data. It is a technique in which the mean of the available examples replaces an attribute's lost value. This technique preserves the sample size and is simple to implement—the Authors filled in the null value using the mean () method. The Authors obtained the anticipated, prepared dataset after filling in all the invalid field entries. Now, if The Authors examine the data set for null values, they will not find any.

3.3. Data organizing

The authors have divided the data into two files to facilitate organization. The authors separated the tested and training data into two folders. The writers additionally utilized a CSV file to store the data, which was generated automatically by google form. This is one of the benefits of working with Google Forms.

3.4. Labeling data

The authors obtained a large amount of categorical data. However, to get the result, the writers had to convert it to numeric form. And to do this, the authors might have utilized Label Encoder in Google Colab in conjunction with Python but instead transformed the text data to numerical data manually because it was more convenient for us. The following Figs. 3.1 and 3.2 illustrate converting a string data set to a numerical data set.

3.5. Data storing

The authors chose Google Drive to store data gathered from current students due to its ease of use. Google Drive generated an appropriate graph for each question, which aided us in comprehending the data's flow and pattern. The authors conducted a study on the saved data in the following stages.

	Gender	Level	Major	CGPA	studyperweek	Involved	Effect	participate activities	ParticipatePlace	ParticipateClub	WhyParticipate	Co-CurricularSpendweek	Notparticipate
0	Female	Bachelor's	Faculty of Business Administration	2.76	3.00	Neither disagree nor agree	Yes, it hampers student's academic performance	No	I am not participate any Co-Curriculum Activities	Other Club	To achieve a better grade	3.0	I want to but I don't get enough time left aft...
1	Male	Bachelor's	Faculty of Arts	2.82	3.00	Agree	It has no effect	No	I am not participate any Co-Curriculum Activities	Not Involved any Activity	I am not participate any Co-Curriculum Activities	0.0	It will hamper my study.
2	Male	Master's	Faculty of Fine Arts	2.68	2.30	Neither disagree nor agree	It has no effect	Yes	Both	Sports	It is my hobby	2.0	I am not sure about my interest.
3	Female	Bachelor's	Medical	3.15	2.76	Strongly agree	Yes, it helps to achieve better grade	Yes	Outside of my educational institute	Literature club	It is my hobby	2.0	I want to but I have too many family/other res...
4	Male	Bachelor's	Faculty of Science	3.45	5.00	Agree	Yes, it helps to achieve better grade	Yes	Inside of my educational institute	Cultural club	It is my hobby	2.0	I am participating Co-Curriculum Activities

Fig. 3.1. Categorical data set.

	Gender	Level	Major	CGPA	Studyperweek	Involved	Effect	Participate_Activities	ParticipatePlace	ParticipateClub	Whyparticipate	CoSpendweek	Notparticipate
0	1	1	2	2.80	11	4	3	0	4	10	8	0	3
1	1	1	2	2.50	11	3	3	0	4	10	8	0	1
2	1	1	6	3.80	24	4	1	1	1	6	1	15	9
3	0	1	6	2.65	11	4	3	0	4	10	8	0	5
4	1	1	5	2.67	24	3	3	0	4	10	8	0	3
5	1	2	6	3.67	24	5	1	1	2	4	3	3	9
6	1	1	6	3.30	21	4	1	1	1	9	5	11	9
7	1	1	1	3.00	16	4	3	1	2	4	3	17	9
8	0	1	1	2.50	21	3	3	0	4	10	8	0	8
9	1	1	3	3.50	36	4	3	1	1	6	2	10	9

Fig. 3.2. Numerical data set.

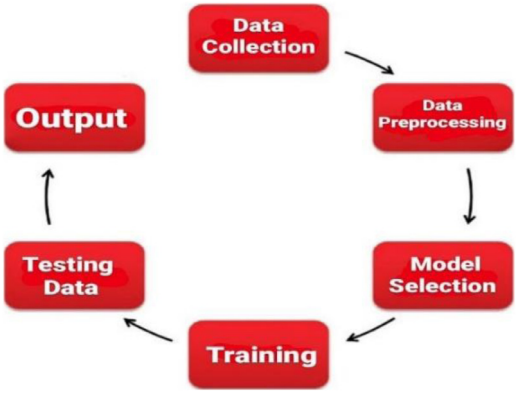

Fig. 3.3. Methodology at a glance.

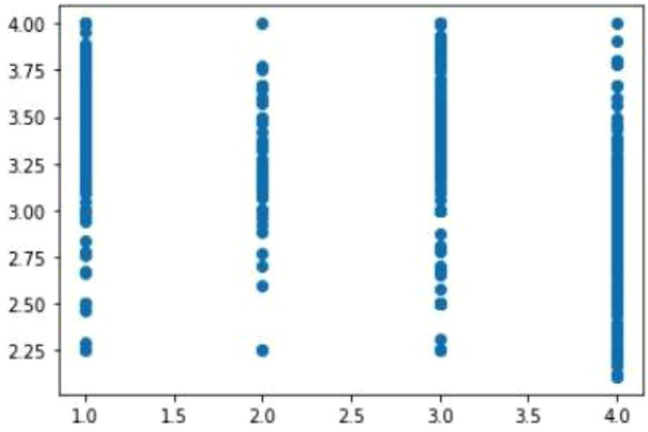

Fig. 4.1. CGPA vs where do you participate in co-curricular activities.

Table 4.1
Accuracy Table.

Algorithm Name	Accuracy
Voted Perceptron	98.6543%
Logistic Regression	99.5294%
Multilayer Perceptron	98.2547%
Random Forest	97.8458%

The authors ran a data set to build a model using the provided data. It produced the desired result. The authors examined the CGPA to involvement in extracurricular activities and found a correlation of 69%. The authors then used the confusion matrix to compare the participation in co-curricular activities to all of the authors' characteristics, which yielded a 99 percent accuracy rate.

4. Result

4.1. Experimental results and analysis

The authors experimented with voting perceptrons, logistic regression, multilayer perceptrons, and the random forest classifier method. Among these, the authors achieved an accuracy of 94.654% in voted perceptron. The authors obtained an accuracy of 99.5294% in logistic regression. The authors also tested the multilayer perceptron and obtained an accuracy of 98.254% . The authors achieved 96.845% accuracy using the random forest method. Thus, the authors chose to work with the function category logistic regression classifier method, providing the highest accuracy rate. Table 4.1 has the actual example.

4.2. The effect of co-curricular activities on academic performance

The scatter graph in Fig. 4.1 illustrates the relationship between a student's CGPA and their participation in extracurricular activities. Such as inside their educational institution, denoted by 01, outside their educational institution, characterized by 02, both within and outside their educational institution, designated by 03, and students who do not engage in co-curricular activities, denoted by 04. From this graph, the writers can observe that students who engage in co-curricular activities inside their educational institution outperform those who participate outside of their educational institution. Nonetheless, one thing is apparent from the graph: students who do not participate in co-curricular activities have a lower CGPA than those who do.

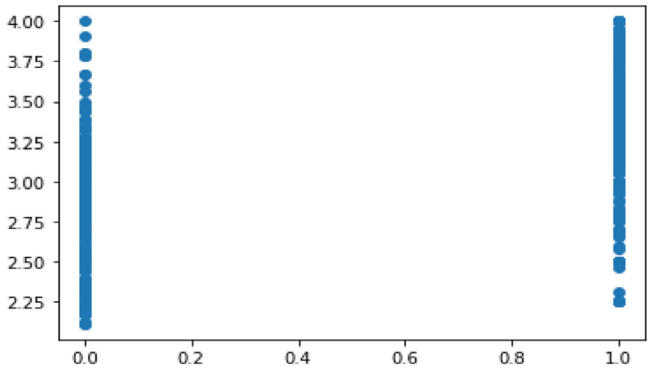

Fig. 4.2. CGPA vs the students thought on involvement in co-curricular activities.

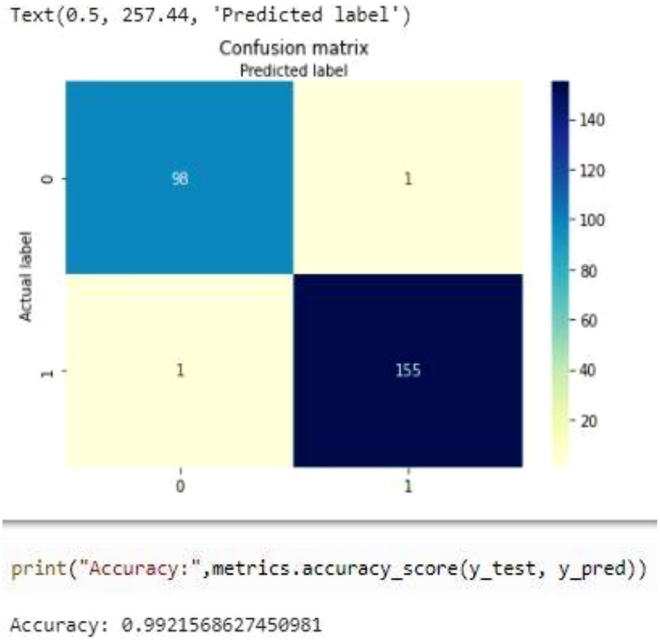

Fig. 4.3. CGPA vs the time students spend in co-curricular activities.

Below the scatter plot, Fig. 4.2 illustrates the relationship between CGPA and students' attitudes toward extracurricular activities. The question was, "Do you believe that students who participate in extracurricular activities are more successful in their professional lives?" One denotes comments vehemently opposed to the statement. 2 indicates the pupils who are contrary to the report. Three represents neither agreeing nor disagreeing answers. 4 and 5 indicate students who agree with the statement and strongly agree with it, respectively. The writers can observe from the graph below that fewer students disagree with their peers than agree with them. This indicates that the majority of students have a favorable attitude toward co-curricular activities. Students who strongly disagree, conflict, and neither disagree nor agree have a lower cumulative grade point average (CGPA) (less than 2.75) than students who agree and strongly agree.

Below graph Fig. 4.3 shows us the relation between CGPA and the time students spend in co-curricular activities. Here 0.0 represents the students who do not participate in co-curricular activities. From the graph, The authors can say that even though students who take part in co-curricular activities spend a lot of hours in co-curricular activities per week but still they have managed to get a higher CGPA (above 3.00) than students who do not participate in co-curricular activities at all (below 2.75).

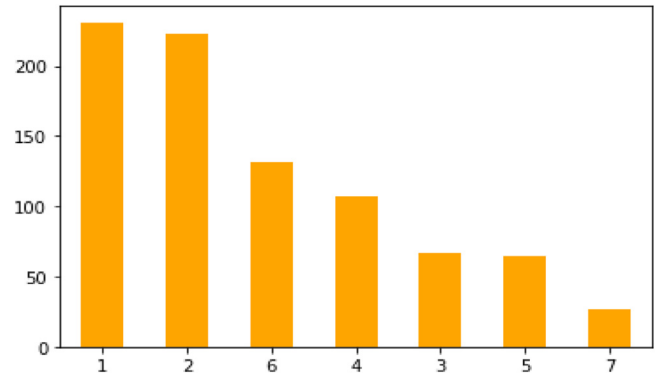

Fig. 4.4. Correlation among Gender, Level, Major, CGPA, Spent Time in study/week, Spent Time in co-curricular activities/week, Clubs, Participation in co-curricular activities.

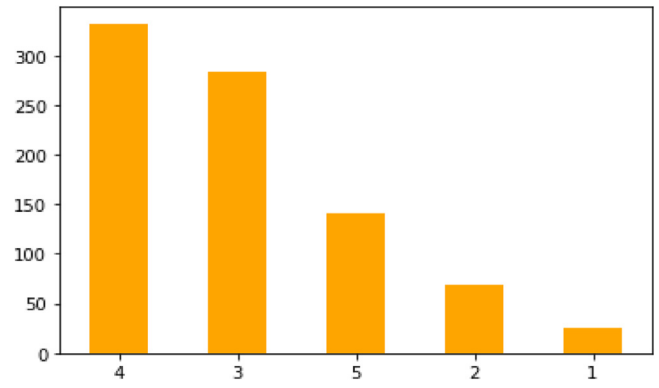

Fig. 4.5. CGPA vs Clubs.

Fig. 4.4 is a built-in graph that illustrates a static table. It is a graph that shows the relationship between each character in the data collection. The following graph illustrates the relationship between gender, CGPA, level, major, time spent studying per week, participating in co-curricular activities per week, clubs, and participation in co-curricular activities. According to the authors, involvement in co-curricular activities connects with the CGPA, which is 0.49. Additionally, the authors observe that time spent on co-curricular activities positively correlates with CGPA, indicating that students are doing better academically despite their involvement in co-curricular activities.

The graph below Fig. 4.5 shows us the relation between CGPA and Clubs. 10 represent the students who do not participate in co-curricular activities. They have a lower rate of CGPA. On the other hand 1, 2, 3, 4, 5, 6, 7, 8, and 9 represent the debating club, literature club, programming club, cultural club, sports, volunteering, robotic club, photography club, and other clubs respectively. Students who are a member of the programming club, volunteering, robotics, and other clubs have a higher rate of CGPA than others clubs and activities.

Below graph Fig. 4.6 shows us the relation between CGPA and Participation in Co-curricular activities. The authors can see that the students who do not participate in co-curricular activities have a lower CGPA (below 2.75) than students who do participate in co-curricular activities. They have a higher rate of CGPA (above 3.00). This graph proves that students who take part in co-curricular activities perform better in their academic activities. This graph also verifies that participation in co-curricular activities has a positive relationship with student's academic results.

Below graph Fig. 4.7 illustrates the confusion matrix with the accuracy of the model. The authors have taken "participation in co-curricular activities" in the *Y*-axis against all the features the authors have in the *X*-

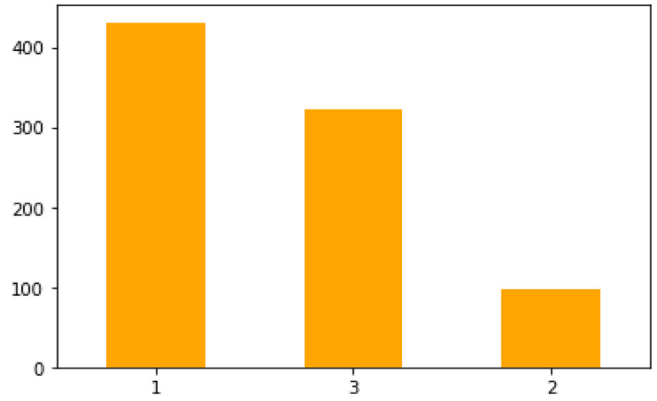

Fig. 4.6. CGPA vs Participation in Co-curricular activities.

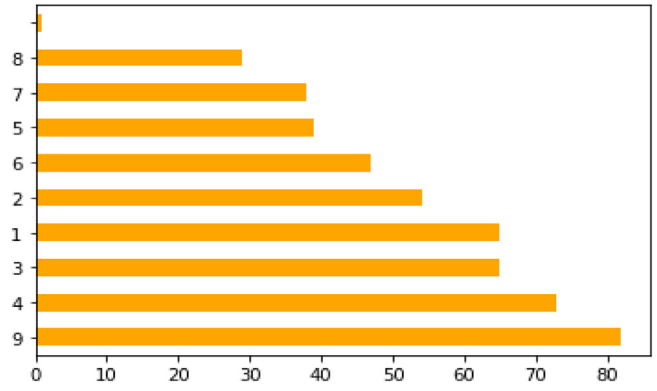

Fig. 4.7. Confusion Matrix.

Table 3.1
Amount of data based on gender.

Gender	Amount
Male	511
Female	339

Table 3.2
demonstration of study level.

Study Level	Amount
Bachelors	636
Masters	214

axis. The authors have managed to achieve 99% accuracy. That proves the efficiency of method and research.

5. Discussion

5.1. Statistical analysis

The amount of total survey data is 850. Among them, 511 Male students filled up forms which are 60.11% of the total response while 339 female students filled up forms which are 39.89% of the total data. The accurate analysis of gender data is shown in Table 3.1.

Among 850 responses, the authors got 636 responses from bachelor students which are 74.82% of total responses and 214 responses from master's students which is 25.18% of total responses. The accurate demonstration is shown in Table 3.2 below.

Among 850 the responses, 27.17% of (231) responses were from faculty of Science which is represented by 1 in below bar graph, 26.24% of (223) responses were from faculty of Engineering represented by 2,

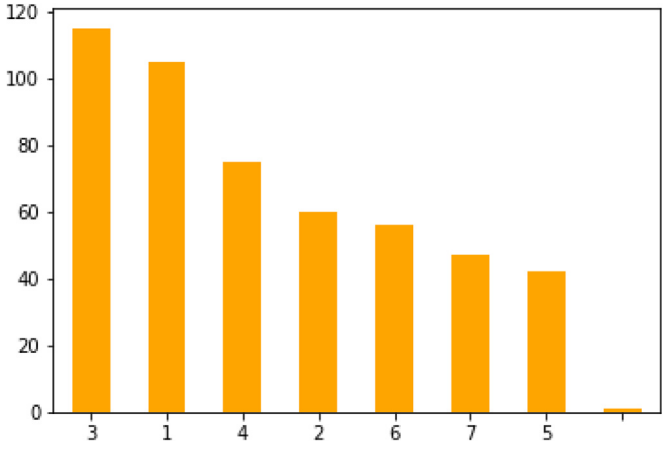

Fig. 3.4. Responses from different faculties.

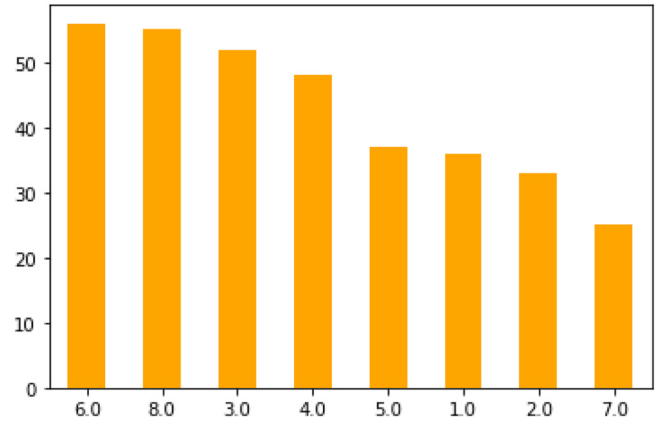

Fig. 3.5. Students thought on involvement.

7.88% of (67) responses were from faculty of Medical represented by 3, 12.58% of (107) responses were from faculty of Art represented by 4, 7.53% of (64) responses were from Faculty of Fine Art represented by 5, 15.41% of (131) responses were from faculty of Business represented by 6, 3.17% of (27) responses were from other faculties represented by 7. Below bar graph Fig. 3.4 illustrates the responses from different faculties.

Below image Fig. 3.5 shows us the thoughts of students about involving in co-curricular activities. The question was "Do you think students who were involved in Co-Curricular activities are more successful in professional life?" 2.94% of (25) students strongly disagree which is represented by 1,8% of (68) students disagree represented by 2, 33.41% of (284) students neither agree nor disagree represented by 3, 39.05% of (332) students agree represented by 4 and 16.59% of (141) students strongly agree.

Below Fig. 3.6 shows that 50.70% of (431) students think co-curricular activities help to achieve better grades represented by 1, 11.41% of (97) students think it hampers represented by 2 and 37.88% of (322) students think it has no effect represented by 3.

Among 850 responses,494 students participate in co-curricular activities which are 58.11% of the total response and 356 students do not participate in co-curricular activities which are 41.89% of the total response. Which is shown in Table 3.3.

Below bar graph is showing the number of participants in each club. Here 1 represents debating club which has 65 responses (13.16%), 2 represents literature club which has 54 responses (10.93%), 3 represents programming club which has 65 responses (13.16%), 4 represents cultural club which has 73 responses (14.77%), 5 represent sports which have 39 responses (7.89%), 6 represents volunteering club which

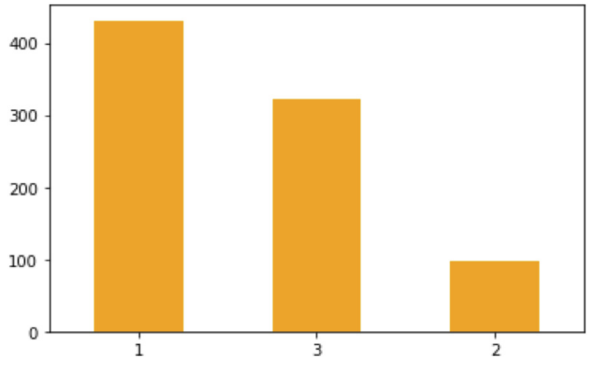

Fig. 3.6. Students Thought on effect.

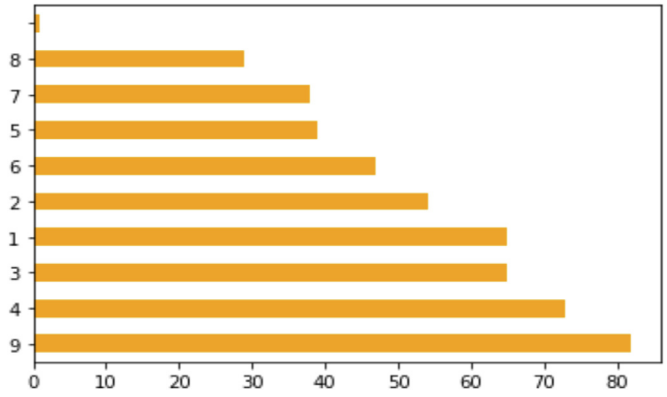

Fig. 3.7. Participation in different clubs.

Table 3.3
Participation in co-curricular activities.

Do you participate in co-curricular activities?	Number of Responses
Yes	494
No	356
Total	850

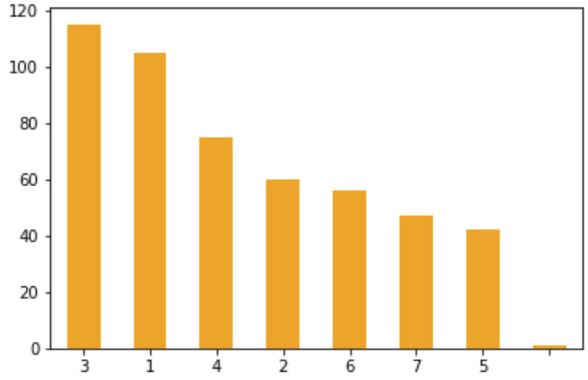

Fig. 3.8. why students participate in co-curricular activities.

has 47 responses (9.51%), 7 represents robotics club which has 38 responses (7.69%), 8 represents photography club which has 29 responses (5.87%), 9 represents other clubs which has 82 responses (16.60%).

Below bar graph Fig. 3.8 is showing, among the students who participate in co-curricular activities, 20.04% (99) of students have said they participate in co-curricular activities to develop their communication skills, which are represented by 1 in the graph. 12.14% (60) of students said they participate to grow their leadership skills, which are represented by 2. The highest number of students 23.28% (115) said that

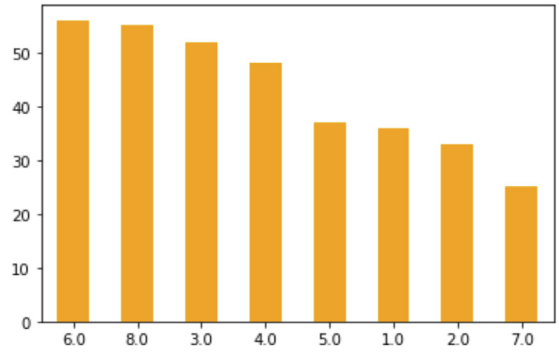

Fig. 3.9. why students do not participate in co-curricular activities.

they do it as it is their hobby, which is represented by 3. 15.18% (75) of the students said they want to achieve better grade that is real by 4. 8.50% (42) of students said they want to build their self-esteem, 11.13% (55) of students said they want to increase their network, 9.51% (47) of students said they participate due to their friends influence which are represented by 5, 6 and 7 in the graph respectively.

Among the students who do not participate in co-curricular activities, 10.96% (39) of students think participation in co-curricular activities is unnecessary which is represented by 1.0.

2.0 represents 9.83% (35) of students who think participation in co-curricular activities may hamper their study. 14.89% (53) students do not participate due to academic pressure, 13.76% (49) of students do not participate because of the family and other responsibility, 10.39% (37) student's parents do not allow them, majority 16.85% (60) of student do not sure about their interest, 7.02% (25) of students' institutions do not create enough opportunity and 15.45% (55) of students are introvert, that's why they do not participate, which are represented by 3.0, 4.0, 5.0, 6.0, 7.0 and 8.0 respectively in the below graph Fig. 3.9.

6. Implementation

6.1. Requirements

• Python 3.8

Python 3.8 is a new version of the Python programming language. It is a high-level programming language. Most of the researchers use it to do their research. It is a highly recommended programming language for AI-based projects and it is loved by the new generation's programmers because it is very easy to learn, understand and use.

• Google CoLab

Google CoLab is an open-source distributor of Python programming language which is completely free to use. The authors can work here online through the browser as well as through Jupiter notebook. It provides us free online virtual GPU access and that is the main benefit of using it.

• Hardware/Software Requirements

a. Operating System (Windows 7 or above)
b. Web Browser (Preferably Chrome)
c. Hard Disk (Minimum 4 GB)
d. Ram (More than 4 GB)

7. Conclusion

In this modern era technology e.g. IoT (Saifuzzaman et al., 2017; Saifuzzaman et al., 2018; Saifuzzaman et al., 2020; Hasan et al., 2020; Hasan et al., 2019), Cybersecurity (Shetu et al., 2019), Machine Learning (S.F. Shetu et al., 2021; M. Saifuzzaman et al., 2021; Mohd. Saifuzzaman et al., 2021; Syeda Farjana Shetu et al., 2021; Rahman et al., 2021; Durjoy et al., 2020) and so on plays a vital role where in our study we

worked on machine learning to predict our desire result to contribute the research area. The writers live in a progressive era where earning a bachelor's or master's degree is no longer sufficient. To be successful in their professional lives, the writers must possess other abilities such as interpersonal skills, communication skills, leadership skills, management skills, and teamwork abilities. However, the writers cannot do this by cramming a theoretical talk into a packed classroom. The writers may acquire these abilities via extracurricular activities. However, there is a widespread misunderstanding that their results will suffer if the writers engage in extracurricular activities. However, the authors believe that this misunderstanding will be dispelled via a research-based initiative, and students will be able to make the suggestion. The writers believe that they will be able to acquire other essential skills and their degrees throughout their time as students. The authors want to improve it in the future and to determine the efficacy of co-curricular activities in various employment sectors.

Data Availability

All data source is available upon request.

Code Availability

All source codes are available upon request.

Data and code availability

The data and code are available upon request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.crbeha.2021.100057.

References

Ahmad, M., Rahman, M.F., Ali, M., Rahman, F., Azad, Al, M, A, 2019. Effect of extra curricular activity on student's academic performance. J. Armed Forces Med. College, Bangladesh, 11 (2), 41–46.

Chi-Hung, C.W. R.N., P.O.E. Chan (2011). Can Co-curricular Activities Enhance the Learning Effectiveness of Students?:An Application to the Sub-degree Students in Hong Kong (ISSN 1812-9129), 23(3), 329-341.

Desai, S.D., Revathi, A., Aishwarya, S.L., Mattur, A., Udasimath, A.V., 2021. Predictive analysis of emotion quotient among youth. In: Proceedings of International Conference on Intelligent Computing, Information and Control Systems. Springer, Singapore, pp. 577–590.

Durjoy, S.M.K., Rafi, A.M.R., Tumpa, Z.N., Saifuzzaman, Mohd., 2020. A comparative study on prediction of dengue fever using machine learning algorithm. on The First International Conference on Advances in Distributed Computing and Machine Learning(ICADCML-2020) on 30th and 31st January.

Gonge, S.S., Khobragade, R.N., Thakare, V.M., Deshpande, V.S., Dhore, M.L., 2021. An innovative step for enhancement in student results and teaching–learning process using educational technology. In: Computational Intelligence in Digital Pedagogy. Springer, Singapore, pp. 235–249.

Hasan, M., Saha, D., Ferdosh, J., Moon, N.N., Saifuzzaman, Mohd., Nur, F.N., 2019. BSSID based monitoring class attendance system using WiFi". on 3rd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2019), The IEEE provides SCOPUS with all of the IEEE Xplore digital library, 12-14, DECEMBER.

Hasan, R., Islam, S., Rahman, Md.H., Saifuzzaman, M., 2020. Syeda farjana shetu and nazmun nessa moon, "Implementation of low cost real-time attendance management system: a comparative study. on IEEE 8TH International Conference on Reliability, Infocom Technologies and Optimization (ICRITO'2020), MARCH 5-6.

Hosen, P., Himel, N., Adil, M.A., Moon, M.N.N., Nur, M.F.N., 2019. Music playing and wallpaper changing system based on emotion from facial expression. In: Emerging Technologies in Data Mining and Information Security. Springer, Singapore, pp. 79–87.

Jackson, D., Bridgstock, R., 2021. What actually works to enhance graduate employability? The relative value of curricular, co-curricular, and extra-curricular learning and paid work. Higher Educ. 81 (4), 723–739.

Magana, A.J., Jaiswal, A., Madamanchi, A., Parker, L.C., Gundlach, E., Ward, M.D., 2021. Characterizing the psychosocial effects of participating in a year-long residential research-oriented learning community. Curr. Psychol. 1–18.

Moon, N.N., Salehin, I., Parvin, M., Hasan, M.M., Talha, I.M., Debnath, S.C., Nur, F.N., Saifuzzaman, M., 2021. A natural language processing based advanced method of unnecessary video detection and the framework model. Int. J. Electr. Comput. Eng. (IJECE).

Moon, N.N., Sarker, K.U., 2011. Size independent Bangla character recognition system by multilayer feedforward neural network. IJCIT 2 (1).

Rahman, Md M., Saifuzzaman, M., Ahmed, A., Mahin, M.F., Shetu, S.F., 2021. Impact of COVID-19 on mental health: a quantitative analysis of anxiety and depression based on regular life and internet use. Current Research in Behavioral Sciences. Elsevier doi:10.1016/j.crbeha.2021.100037.

Ramalingam, M., Ilakkiya, R., 2021. Data mining algorithms (KNN & DT) based predictive analysis on selected candidates in academic performance. In: 2021 11th International Conference on Cloud Computing, Data Science & Engineering (Confluence), IEEE, pp. 332–337.

Saifuzzaman, M., Parvin, M., Jahan, I., Moon, N.N., Nur, F.N., Shetu, S.F., 2021a. Machine Learning Approach to Predict SGPA and CGPA. 2021 International Conference on Artificial Intelligence and Computer Science Technology (ICAICST), 29th - 30th June 2021.

Saifuzzaman, M., Khan, A.H., Moon, N.N., Nur, F.N., 2017. "Smart security for an organization based on IoT" on. Int. J. Comput. Appl. (IJCA) 165 (10) NumberMayNew York, USA.

Saifuzzaman, M., Moon, N.N., Nur, F.N., 2018. "IoT based street lighting and traffic management system. IEEE Region 10 Humanitarian Technology Conference (R10-HTC).

Saifuzzaman, M., Rahman, Md M., Shetu, S.F., Moon, N.N., 2021b. COVID-19 and Bangladesh: situation report, comparative analysis, and case study. Current Research in Behavioral Sciences. Elsevier doi:10.1016/j.crbeha.2021.100034.

Saifuzzaman, M., Shetu, S.F., Moon, N.N., Nur, F.N., Ali, M.H., 2020. IoT based street lighting using dual axis solar tracker and effective traffic management system using deep learning: Bangladesh context. 11th International Conference on Computing, Communication And Networking Technologies (ICCCNT 2020), July 1-3.

Salehin, I., Dip, S.T., Talha, I.M., Rayhan, I., Nammi, K.F., 2021. Impact on human mental behavior after pass through a long time home quarantine using machine learning. Int. J. Educ. Manag. Eng. (IJEME) 11 (1), 41–50. doi:10.5815/ijeme.2021.01.05.

Salehin, I., Talha, I.M., Hasan, M.M., Dip, S.T., Saifuzzaman, M., Moon, N.N., 2020a. An artificial intelligence based rainfall prediction using LSTM and neural network. In: 2020 IEEE International Women in Engineering (WIE) Conference on Electrical and Computer Engineering (WIECON-ECE), IEEE, pp. 5–8.

Salehin, I., Talha, I.M., Moon, N.N., Saifuzzaman, M., Nur, F.N., Akter, M., 2020b. Predicting the depression level of excessive use of mobile phone: decision tree and linear regression algorithm. on 2nd International Conference on Sustainable Engineering and Creative Computing (ICSECC-2020), 16 - 17 December.

Salehin, I., Talha, I.M., Saifuzzaman, M., Moon, N.N., Nur, F.N., 2020c. An advanced method of treating agricultural crops using image processing algorithms and image data processing systems. In: 2020 IEEE 5th International Conference on Computing Communication and Automation (ICCCA), IEEE, pp. 720–724.

Sarker, K.U., Moon, N.N., Ahmed, S., 2011. Classifying the practitioner's behavior in medical informatics by using data mining. Int. J. Comput. Inf. Technol. 1 (2), 23–25.

Shetu, S.F., Saifuzzaman, M., Parvin, M., Moon, N.N., Yousuf, R., Sultana, S., 2020a. Identifying the writing style of bangla language using natural language processing. In: 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT), IEEE, pp. 1–6.

Shetu, S.F., Saifuzzaman, M., Sultana, S., Yousuf, R., Moon, N.N., 2020b. Students performance prediction through education data mining depending on overall academic status and environment. 3rd International Conference on Innovative Computing and Communication (ICICC-2020) on.

Shetu, S.F., Jahan, I., Islam, M.M., Hossain, R.A., Moon, N.N., Nur, F.N., 2021a. Predicting satisfaction of online banking system in Bangladesh by machine learning. 2021 International Conference on Artificial Intelligence and Computer Science Technology (ICAICST), 29th - 30th June 2021.

Shetu, S.F., Rahman, M.M., Ahmed, A., Mahin, M.F., Akib, Md A.U., Saifuzzaman, M., 2021b. Impactful E-learning framework: a new hybrid form of education. Current Research in Behavioral Sciences. Elsevier doi:10.1016/j.crbeha.2021.100038.

Shetu, S.F., Saifuzzaman, M., Moon, N.N., Nur, F.N., 2019. "A Survey of Botnet in Cyber Security" on 2nd International Conference On Intelligent Communication and Computational Techniques (ICCT-2019), IEEE Conference.

Singh, A., 2017. Effect of co-curricular activities on academic achievement of students. IRA Int. J. Educ. Multidiscip. Stud. 6 (3), 241–254 (ISSN 2455-2526).

Talha, I.M., Salehin, I., Debnath, S.C., Saifuzzaman, M., Moon, M.N.N., Nur, F.N., 2020. Human behaviour impact to use of smartphones with the python implementation using naive Bayesian. In: 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT), IEEE, pp. 1–6.

Ullah, M.S., Nur, F.N., Moon, N.N., 2015. Optimization of wireless ad-hoc networks using an adjacent collaborative directional MAC (ACDM) protocol. Int. J. Comput. Appl. 114 (3).