

Innovative machine learning approach and evaluation for predicting the Study and Work life balance among Students within the South Korean Higher Education system

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Abstract: Work-life balance is important to maintaining a sustainable balance between student study and work life. There are various positive factors associated with it like it increases the productivity of students and reduces the mental pressure on the student. In this research, we aim to find out the factors which affect the student's work-life balance and predict the work-life balance with the help of Machine learning algorithms. The dataset was collected by taking a survey of the students of Hannam University. After that SelectKBest algorithm finds the most crucial factors in predicting the student work-life balance. Three machine learning algorithms are used Balanced random forest classifier, logistic regression, and neural network. To evaluate the performance, metrics like accuracy, precision, recall, and f1 score were used. The result shows that the SLB_3 was the most important factor, and the neural network performed best among all, with an accuracy of 83%. On the other hand, logistic regression and balanced random forest classifier have got an accuracy of 80.85% and 72.34%, respectively.

Article History

Received: 16.11.2023

Accepted: 28.11.2023

Published: 25.12.2023

Keywords: Work-Life Balance, Machine Learning in Education, Student Well-being, Predictive Analytics in Higher Education, Educational Data Mining, South Korean Higher Education System, Student Productivity.

Introduction

Work-life balance is one the hottest topics of research since the work-from-home culture has started, and people around the world love this type of culture as they have found a perfect work-life balance while staying at home with their families. Students, on the other hand, also find this type of study and work-life balance the perfect way to learn and give enough time to their studies. With the pandemic, several e-learning platforms have been introduced, and universities have promoted the use of meeting apps through which lectures are delivered. As the pandemic hit humankind and a global lockdown was announced all over the world, the industries were shut down, and people were sent to their homes with a situation of undefined break (Saif, Rehman and Alam, 2020). However, after a few months, the government-mandated work from home culture for industries. Universities can work with employees, professors, and students without being physically present, which promotes e-learning and online lectures. The diversity in various fields of technology in this era is revolutionizing the world, and with the development of technologies, the work-life balance of humans has greatly improved. However, there are still a lot of places for improvement (K and M, 2021). Remote work culture can be considered a huge leap in the improvement of work-life balance.

Work-life balance is really necessary for maintaining sustainable well-being and also helps in the mental wellness of the students. There are several positive factors that come into play when a balanced study and work-life culture is provided to the students. Spending quality time on their own, fewer hours of work,

vacations, and several other factors help increase the productivity of the students, which leads to more time gain and knowledge for students. In this rapidly evolving world, the industries are facing several challenges, and these challenges are brought through the upcoming technology, which is developed at a rapid rate on a daily basis (Byrne, 2005). As a result, universities are digitalizing themselves, which is done to promote online education and provide more information and time to the students, and now almost every place can be transformed into a virtual office or university where students can virtually represent themselves and submit their projects or their work in an online port. The work-life balance directly impacts the productivity of the students. The presence of stress and anxiety is mainly due to an unbalanced work-life structure, and it must be taken care of to improve the quality of life (Matulevicius *et al.*, 2021). The machine learning model to predict study work-life balance in students will help the university to reduce the costs of students in the matter of university fee. Thus, this model will help both the categories in an equivalent manner.

Machine learning is an upcoming technology that has the ability to provide automation and can help us in making forecasts and predictions using the dataset by improving its experience and gaining human-like intelligence. Machine learning focuses on developing those computer programs and software which access the data and use this dataset to learn for themselves. In this research paper, an innovative machine learning approach for the prediction of study work-life balance among the students is being studied, and a comparative analysis of different classification algorithms is performed (Lewis and Humbert, 2010). The work-life

balance of different people depends on different factors, and it is different for various people depending on their situations. It may depend on factors such as age, gender, and education. Marital status, children, having adult dependents, general seniority, year of experience, size of the organization, category of occupation, etc. Based on all these factors, we can design a machine learning model to classify the key factors and work on the well-being of these employees (Bellmann and Hübler, 2020).

This research paper provides a brief idea about study work-life balance, its impacts, and how it can be predicted using machine learning techniques. Then, the literature review is provided, which discusses the various researches and works done to date. After that, the methodology is presented, where the discussion of the research experiment is presented, and then the result and analysis section provide us with the accuracy of the models along with their comparison with other models. Finally, the discussion of the research is presented, and the research paper ends with a conclusion and future work. This research paper provides an experimental setup that has been considered through research and innovative experiments, which leads to wonderful results. This research will help people to find a better study work-life balance and help people and organizations to increase their productivity.

Literature review

As the world is rapidly changing to a path with a better work-life balance for employees and students, the authors of this research paper (Hamberger, 2007) presents some reviews on how the faculties for next generation can be trained so that they are able to provide quality education to students. Graduation is an important phase in universities and after this phase people enter their respective workplace which demands that the students for ready for those challenges in a more determined and experienced manner which demands a distinguished life style of the faculties. Therefore, interaction with peers is an important step in this context. ('A Comparative Study of Work Life Balance among Higher Education Students in ASEM Courses', 2017) proposes a comparative study which focuses on the work-life balance among higher education students in ASEM courses. Therefore, in the recent years the work-life has been gaining importance which can be provided through factors like emotional, imaginative, spiritual, intellectual and physical balance in life.

Work-life balance is a form of routine which must be followed by every employer and their employees as it also affects the productivity of employees and promotes innovation which is the key to success in every industry (Ryan and Hwang, 2019). Since 2020, after the impact of covid-19, the situation of working from home has massively increased, and employees prefer to work from home more than work from the office (Natarajan *et al.*, 2021) as it provides them the benefits of spending time with their families and taking care of their own kids which was considered difficult during earlier days. Machine learning has been a very powerful tool for the implementation of artificial intelligence and helps us to solve various problems through automation (Choi and Choi, 2020). Therefore, data scientists and researchers working in the field of work-life balance have been working on building a machine learning model for the analysis of work-life balance among employees.

Emotional intelligence is a factor that is developed within humans and is responsible for maintaining our social skills and how we

perform at our work. It is a very necessary factor and helps in determining the work-life balance of an employee. (JuliaGrace and Nasreen Banu, 2015) presented a research paper in which the impact of emotional intelligence on productivity and job satisfaction is examined through machine learning techniques. This research has been performed by evaluating the ability of employees, their self-awareness, sensitivity, influence, or motivational level. Through this research, the strong and weak points of the employees are analyzed, and then the inferences are analyzed using machine learning algorithms. In this research (JuliaGrace and Nasreen Banu, 2015) four factors of emotional intelligence are considered, awareness, regulation, social skills, and empathy. Machine learning is then implemented on the dataset using classification and clustering techniques for data mining and inference which is summarized using the WEKA tool.

The work-life balance of IT employees has changed a lot after the pandemic situations, and although work-life balance is a concern for other fields as well as IT, the field has been greatly impacted by pandemics (Saif, Rehman and Alam, 2020). During the pandemic, several companies and industries were closed, but the IT industry was one of the first fields to resume its work. With the government's mandate IT industry transitioned to work from a home model, which resulted in a success and continued smooth business continuity with their clients without decreasing the productivity of their products (Natarajan *et al.*, 2021). Various factors such as working environment, distractions, stress factors, and communication are responsible for an IT employee being productive at work (Byrne, 2005). However, considering the situation of working from home, the productivity of employees rather increased as they were able to spend quality time with their family and work at the same time.

Similar to the situations of IT industries and their work-life balance, students pursuing higher education were also able to find satisfaction and excellence while discovering the relationship between work-life balance and E-learning facilities. In the research conducted by (Bucea-Manea-Țoniș *et al.*, 2020) a total of 1032 participants were recruited from several countries to investigate the perceptions of e-learning on students pursuing higher education. The data collected was analyzed using PSPP and SPSS through descriptive techniques where a machine learning regression model to evaluate work-life balance was trained and evaluated. The model showed that an increased level of living standard and culture is positively influenced by the e-learning process (Lewis and Humbert, 2010). This research also reveals that a lot of expenses are saved by the students through the e-learning process, such as transportation, health expenses, food expenses, and rental charges (Bellmann and Hübler, 2020). E-learning promotes innovations, creativity, and productivity among the employees if they are provided with efficient training by maintaining communication between the trainer and students.

Due to improper work-life balance, many industries have been facing employee attrition, and several employees who fail to complete their work by the deadline are being removed by companies (Matulevicius *et al.*, 2021). This is happening due to increased stress levels or poor work-life balance of the employees, and therefore it has become a focus of researchers and human resources, leading several companies to work on the way to reduce employee attrition. Machine learning models have been used recently to predict employee attribution, and the classification

algorithms can effectively predict whether an employee is likely to quit. The authors of this research paper (Mansor, Sani and Aliff, 2021) propose machine learning models like decision trees classifier, artificial neural networks, and support vector machines to predict employee attrition. The IBM human resource analytic employee attrition and performance dataset is being used for training the models, and then the models were compared where the optimized SVM model performed the best, acquiring an accuracy of 88.87%. Considering several research papers, SVM, C5 decision trees, decision trees, extreme gradient XGBoost, ANN, logistic regression, etc., are a few models which performed the best among other classifiers (Saradhi and Palshikar, 2011; D.Alao, 2013; Luoma and Saarinen, 2020).

Remote working, which is a form of work from home, is a kind of tradition which is being followed by various youths and even by several employees, where the most of them are IT employees. (Felstead and Henseke, 2017) proposes a research paper addressing the situation of work-life balance and well-being of employees considering the growth of remote work and its consequences. This research assumes that remote work is a win-win situation for both employer and employees, and the culture of remote work is increasing more and more per day. The research performed by (Felstead and Henseke, 2017) also shows that females are more attracted to remote work, and their number is increasing every year. To experimentally analyze the work-life balance among the employee's machine learning approach was implemented in a research paper proposed by (K and M, 2021) where a dataset of 12,7756 people was collected and taken into consideration for the analysis. 80% of this dataset is trained through a random forest classifier, SVM, and Naïve Bayes algorithm. An accuracy of 71.5% is obtained through the models. Data visualization is performed through bar plots and correlation plots, and factors such as sleeping hours and job satisfaction are considered for work-life balance.

Thus work-life balance is also maintained through job involvement of the employees, and to study the data for job involvement prediction, the authors of this research paper (Choi and Choi, 2020)

present a methodology based on machine learning techniques and the dataset used for this research is the IBM dataset. Two primary approaches are implemented in this study, first to understand the roles of variables in job involvement and second to evaluate the predictive performance of GLM, which includes linear regression and binomial classification. This paper claims to be the first one with the best-performing model in the prediction of job involvement using machine learning techniques and employee demographics (D.Alao, 2013). An accuracy of 68% is obtained through this model, which performs the modelling on a large number of factors.

Machine learning, in particular, will improve several aspects of the daily life of individuals, which will improve the overall quality of life of employees and will help them try and find ways of achieving a balance of work-life. The authors of this research paper (Pawlicka *et al.*, 2020) utilize a machine learning tool to search the factors that influence the subjective feeling of work-life balance, and for that, an exceptionally sizeable group of 8800 employees was utilized. Through analysis of several factors and experiments, the selectKbest algorithm is implemented, which works through ANN with two hidden layers, and 50 and 25 neurons are used for the construction of ReLU and ADAM with an accuracy of 81%. As compared to the general population, people having satisfaction with work-life balance find life more enjoyable, and their motivation to live on also increases with a better work-life balance (Shanafelt *et al.*, 2012). Various researchers have been working on this field, and since the covid-19 pandemic, the work-life balance has been one of the most discussed topics.

Research questions

There is two research question that I am going to answer with my research experiment.

RQ1. Which factors have the highest predictive power for predicting the study and work-life balance among students?

RQ2. Out of all the algorithms, which algorithms give the best performance in predicting the study and work-life balance of a student.

Num.	Feature	Type	Description
1	Date	datetime	On which date the survey was taken
2	Age	Continuous	Age of the student in years
3	Gender	Discrete	Gender (1 = male; 2 = Female)
4	Place of residence	Discrete	The place where the student resides. (1= Daejeon, 2= Outside of Daejeon)
5	Number of Majors taken	Discrete	It represents number of majors student takes. (1= student takes one major, 2= more than one major)
6	Major	Discrete	It represents the major names (1= Business, 2= Other Majors)
7	No of hours spent a week on university classes/lectures, etc.	Discrete	It represents number of hours spend per week in the university. (1= under 12 hours, 2= more than 12 hours)
8	No of hours spent a week on self-study	Discrete	It represents the total no of classes taken per week (1= under 12 hours, 2= more than 12 hours)

9	Do you ever have classes on weekends?	Discrete	The values are in Yes or no format.
10	Do you ever study on weekends?	Discrete	The values are in Yes or no format.
11	Do you ever study at night?	Discrete	The values are in Yes or no format.
12	Do you have to commute to your university?	Discrete	The values are in Yes or no format.
13	How many hours a week do you spend commuting to your university?		(1= under 1 hour, 2= more than one hour)
14	Do you have a job?	Discrete	The values are in Yes or no format.
15	No of hour spend in a week for the job	Discrete	It represents the no of hour spend per week on the job. (0= no work, 1= under 12 hours, 2= more than 12 hours)
16	If you have a job, do you ever work at weekends?	Discrete	The values are in Yes or no format.
17	If you have a job, do you ever work at nights?	Discrete	The values are in Yes or no format.
18	Do you have to commute to your workplace?	Discrete	The values are in Yes or no format.
19	If yes, how many hours a week do you spend commuting to your workplace?	Discrete	It represents no of hours spend per week by student in commuting to the workplace (1= under 1 hour, 2= more than one hour)
20	SLB_1	Discrete	It denotes that the student has sufficient time away from my study at university to maintain adequate work and personal/family life balance. The values are in scale of 0 to 5 where (1= strongly agree; 2= somewhat agree; 3= neutral; 4= somewhat disagree; 5= strongly disagree)
21	SLB_2	Discrete	It denotes that the student has a good balance between the time spent at university and the time available for non-study activities. The values are in scale of 0 to 5 where (1= strongly agree; 2= somewhat agree; 3= neutral; 4= somewhat disagree; 5= strongly disagree)
22	SLB_3	Discrete	It denotes that the student feels that the balance between my study demands, and non-study activities is right.
23	SLB_4	Discrete	It denotes that the student is able to negotiate and accomplish what is expected in the study and personal life.
24	SLB_5	Discrete	It denotes that the student is able to able to accomplish the expectations that my professors and my family have for me.
25	PSD_1	Discrete	It denotes that the study requires all of my attention.
26	PSD_2	Discrete	It denotes that the student feels like have a lot of study demand.
27	PSD_3	Discrete	It denotes that the student feels like have a lot to do at university.

28	PSD_4	Discrete	It denotes that the study requires a lot from the student.
29	PSD_5	Discrete	It denotes that the student has given a lot of studies to do.
30	PS_1	Discrete	My professor understands my family demands.
31	PS_2	Discrete	My professor listens when I talk about my family.
32	PS_3	Discrete	My professor acknowledges that I have obligations as a family member.
33	PS_4	Discrete	My professor is a good role model for study and nonstudy balance
34	PS_5	Discrete	My Professor demonstrates how a person can jointly be successful on and off the job.
35	SS_1	Discrete	The study is like hobby for the student.
36	SS_2	Discrete	The study is usually interesting enough to keep a student from getting bored.
37	SS_3	Discrete	The student feels that I am happier in my study than most other people.
38	SS_4	Discrete	
39	SS_5	Discrete	The student finds real enjoyment in their studies.
40	LS_1	Discrete	The student life is close its ideal
41	LS_2	Discrete	Student life condition is excellent.
42	LS_3	Discrete	Student is satisfied with his life
43	LS_4	Discrete	So far student have gotten the important things he or she want in life
44	LS_5	Discrete	If I could live my life over, I would change almost nothing
45	OC_1	Discrete	Student is willing to put in a great deal of effort beyond that normally expected in order to help this university be successful.
46	OC_2	Discrete	Student talk up this university to my friends as a great organisation to work for
47	OC_3	Discrete	Student would accept almost any type of study assignment in order to keep studying for this organisation.
48	OC_4	Discrete	Student find that his values and the university's values are very similar.
49	OC_5	Discrete	For the student this is the best university for which to study.
50	IRP_1	Discrete	Student adequately complete assigned duties.
51	IRP_2	Discrete	Student meet formal performance requirements of my studies
52	IRP_3	Discrete	Student fulfil responsibilities specified in the class curriculum
53	IRP_4	Discrete	Student engage in activities that can positively affect my performance evaluation.
54	IRP_5	Discrete	Student perform tasks that are expected to him

55	ERP_1	Discrete	Student can make constructive suggestions to the overall functioning of my study group
56	ERP_2	Discrete	Student encourage others to try new and more effective ways of doing their studies
57	ERP_3	Discrete	Student is well informed where opinion might benefit studies
58	ERP_4	Discrete	Student continue to look for new ways to improve the effectiveness of my studies.
59	Target	Discrete	Do you think your school activities are in balance with your private life (and work)

Research Methodology

The dataset was collected by taking a survey of the students of Hannam University. Initially, the data problems, so the data pre-processing is applied to improve the classifier performance. Pre-processing involves various operations like taking care of missing values, mismatched data types, and the features transformation technique to make data on the same scale. In fig (1), you can see the steps that have been used in this experiment.

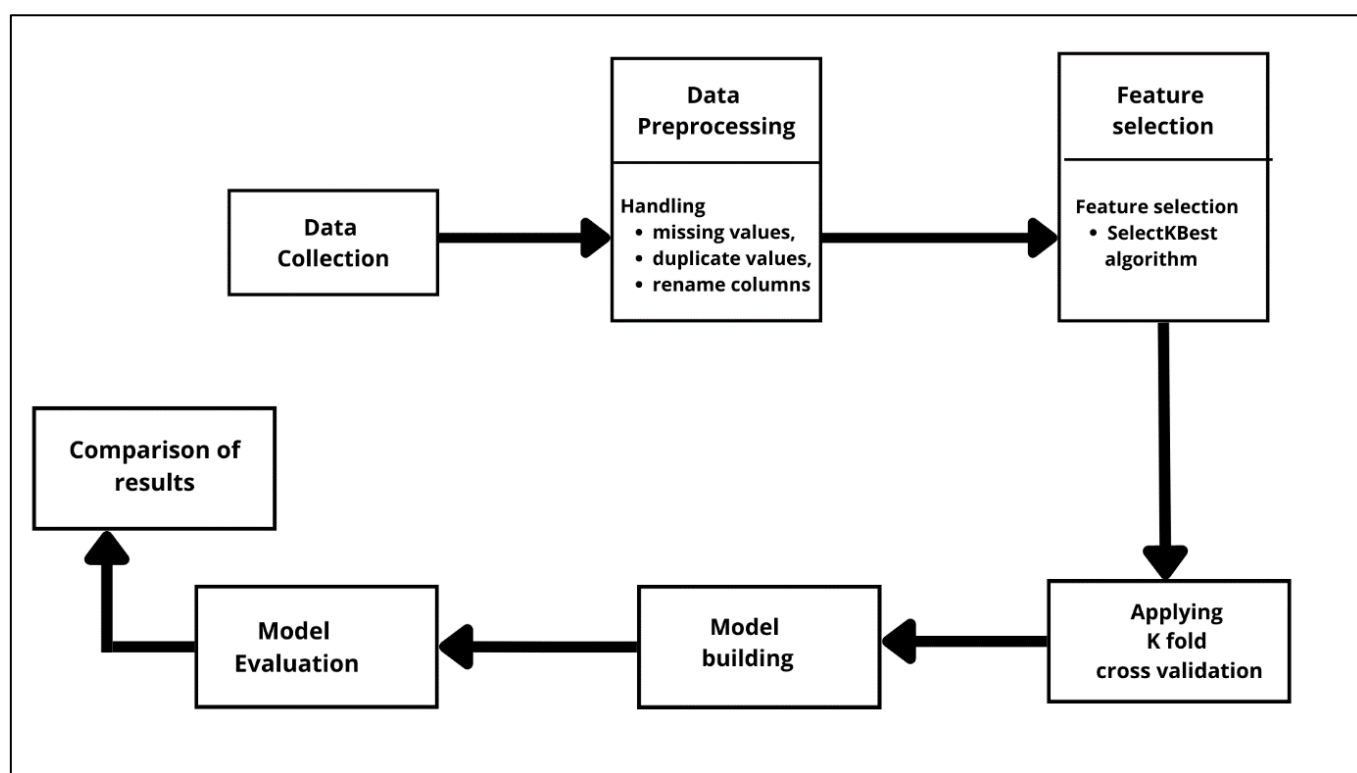


Figure 1- Workflow diagram of the project

Preprocessing Phase

The first step is performed data cleaning operation like handling missing values, duplicate values and the rename the column name into small lengths. Second, drop out the unnecessary columns from the dataset. Third, split the dataset into training and test subsets.

Feature selection

Feature selection is an approach for selecting the subset of the most relevant features in the dataset. It is used to find the most important factors concerning predicting the work-life balance. In our work, I used the SelectKBest algorithm to find the dataset's top 15 most important attributes.

SelectKBest is a feature selection method that can be used for selecting the best features of a given dataset. It selects the

features according to the k highest score and can be applied for both classification and regression data. SelectKBest takes a score function as a parameter applicable to a pair (X, y) where the score function returns an array of scores. SelectKBest then retains the first k features of X that have the highest scores.

Training and Classification

To reduce the bias associated with the dataset, we have used 5-fold cross-validation techniques after the completion of data pre-processing. This technique split the dataset into K folds, and each fold has equal samples in it. After that, the classification model is trained and tested K times. Each time, K-1 subsets are used for training, and the remaining subset is used for testing. These classification algorithms are used logistic regression, balanced random forest classifier, and neural network. A logistic regression

algorithm was used to predict the binary outcome based on the preliminary observation of the dataset. The balanced random forest classifier uses undersampling techniques to balance the dataset. Last, the neural network uses the concept of neurons to learn new information and uses backpropagation techniques to minimize the loss. Lastly, to optimize the model's performance, I have tuned the hyperparameter of logistic regression and balanced random forest classifier.

Performance Evaluation Criteria

In this study, we have used five classification measures to evaluate the performance of the classification algorithm. The metrics are precision, recall, f1 score, ROC curve, and accuracy. All these metrics are derived by using four values like True positive (TP), True negative (TN), False positive (FP) and False negatives (FN).

$$\text{Accuracy} = \frac{(TP+TN)}{(TP+TN+FP+FN)} \quad (1)$$

$$\text{Precision} = \frac{TP}{(TP+FP)} \quad (2)$$

$$\text{Recall} = \frac{TP}{(TP+FN)} \quad (3)$$

$$\text{F1 score} = \frac{2 * \text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \quad (4)$$

	Precision	Recall	F1 score	Accuracy
Neural network	83.72%	97%	90%	83%
Logistic regression	80.43%	100%	89.15%	80.85%
Balanced random forest classifier	87.5%	75.67%	81.15%	72.34%

Discussion

In this study, we have used a set of machine learning and deep learning algorithms to predict the stud/work life balance among the students. Now with the help of experiments we can answer our research questions given as follows.

RQ1: Which factors has the highest predictive power in helping the model to predict accurately?

To find out most important factor SelectKBest algorithm is used. The model finds several features which are relevant for predicting the stwork life balance among the students. Out of all the factors the SLB_3 (student feels that the balance between my study demands and non-study activities is right.) is having the highest predictive power which can help the model to predict accurately.

RQ2: Out of all the algorithms which algorithms gives the best performance in predicting the work life balance of a student.

Neural network is the best algorithm in the terms of performance. It gives an accuracy of 83% which outperforms all other machine learning algorithms like logistic regression, and balanced random forest classifier.

There is one major drawback in our study is the limited sample size. Due to this it is often challenging to train a deep learning or machine learning model and obtain the optimum model performance.

Results

Firstly, logistic regression algorithm is applied with the random state parameter set to 0. After that, we tuned the hyperparameters for all the classifiers to optimize the performance. we have tuned parameters like solver, penalty, C, and class weight for the logistic regression. Similarly, for the balanced random forest, I have tuned the number of estimators values from 10 to 100 with the step of 10. The optimal hyperparameters for the logistic regression were C= 0.05, class_weight= {0: 1, 1: 3}, penalty = 'l2', and solver= 'newton-cg'. The optimal hyperparameters were 60 estimators for a balanced random forest classifier. To have an average estimation of metrics, 5-fold cross-validation is used for conducting the machine learning experiment.

Last, the neural network model was trained for 100 epochs. And after the completion of 100 epochs, the model achieves an accuracy of 83%. Other metrics like precision, recall, and f1 score is 83%,97%, and 90%. The model performance was evaluated with classification metrics like accuracy, precision, recall, and f1 score in Table 1. The neural network gives the best performance with 93% prediction accuracy. Other algorithms like logistic regression and balanced random forest classifier give a competitive performance, and it is only lagged by a few percentages.

Conclusion

Study and work life balance for student is considered as hottest topic because due to the increase in workload and stress among the students. The dataset was collected by conducting a survey of the students of Hannam University. Then the data analysis is performed to explore the data, and after that, data preprocessing was applied to clean the data. SelectKBest algorithm was used to find out the most important factors. The result that we have found is that SLB3 was the crucial factor in predicting the student's work-life balance. The study uses three different algorithms such as neural network, balanced random forest classifier, and logistic regression in order to predict student work-life balance. The result shows us that the neural network outperforms all other algorithms by giving an accuracy of 83%, precision, recall, and f1 score are 83.72%, 97%, and 90%.

There is one limitation that we have found is the small size of the dataset, which impacts the performance of the model. In future work, we will try to collect more and more data in order to improve the model performance.

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