# Enhanced Teacher Performance Evaluation Model using RareDTree Algorithm

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#### Abstract

Data mining techniques are widely used in decision making process across the different area. Educational Data Mining (EDM) system has challenging problem of teacher performance evaluation. Most of the existing studies of teacher evaluation are based on traditional classification algorithm which produces biased result. They neglect the rare but vital factor of complexity of subject and less attendance of student in evaluation process. Students survey based teacher performance evaluation system suffers from biased feedback of students. Usually students give negative feedback to the teachers who taught tough subjects. Most of the existing prediction studies ignore such rare but important factors. Improper evaluation of good teacher decreases the quality of education system. In our study we used RareDTree algorithm for unbalanced data classification and compare its result with existing studies. We found noticeable improvements in accurate teacher performance evaluation as compared to the other recent methods.

*Keywords: EDM*, *Unbalanced data*, *Classification*, *Prediction*, *RareDTree*, *Machine learning*.

# **1. Introduction**

As per [4], graduate engineers are not up to the standards set by industries. Students are lacking of knowledge and struggle to withstand in competitive market. For any university it is very important to produce high skill graduates through high skill teachers. Prediction of teacher performance and investigation of various factors to improve the quality of education system is challenging task. Student feedback is one of the important techniques of teacher performance prediction [3].

There are different methods of teacher evaluation [3, 4]. But performance evaluation based on student survey using series of question through feedback form is common tool. This feedback database contains hidden knowledge of teacher performance. Knowledge discovery techniques need to be applied on this dataset to get this hidden knowledge.

Knowledge discovery is a data mining technique of knowledge extraction from large, unorganized data. Data Mining is used in many problems like medical diagnosis, traffic analysis and sentiment mining [1].

Existing teacher evaluation system based on student survey could be a biased evaluation. There are subjects which tough to teach and tough to learn. In case of complex subjects, students give less rating to the teacher who teaches it [8]. On other hand, teacher who teaches interesting and less complex subject may have good ratings. However complex subjects are less in number. Classification algorithm like ANN, SVM and decision tree does not have capability to handle such minority class of subjects as these algorithms experiences sudden drop in performance for minority instances of unbalanced data [1].

Attendance - which indicates seriousness of feedback is also one of the important parameter. As per Necla Gunduz et al. [8], if student is not

dedicated, their feedback should not be taken seriously.

1.1 Data Mining Classification

Classification has two steps- Learning and classification [10]. In learning steps the classifier is constructed from training data set and in classification step test dataset is classified by classifier. Our research is about evolution of teachers. It is about classification of faculties in predefined level as per the student's feedbacks. Classification technique best suited to our study. As per [10] there are various classification techniques available like, Decision tree, Naïve-Bayesian, Neural network, Support vector machine, Classification by association rules etc.

### **1.2 Imbalanced Data Classification**

Imbalanced dataset may have unequal class distribution [9]. This means one class of instances outnumber by other class of instances [7, 9]. Imbalanced dataset with only two classes is called a binary-class imbalanced dataset and which has more than two classes is known as multi-class imbalanced dataset. Imbalance ratio (IR) gives depth of imbalance within dataset.

Rare class classification is data mining task for building a model that can correctly predict both the majority and minority classes [1]. Classifying minority or rare class is difficult because the rare class is too small and mostly they ignore by classification model. Most of the classification techniques give more importance to majority class instances [9].

In universities, teacher who teaches tough and uninterested subjects are in comparatively less numbers and mostly receives negative feedback from students because of high difficulty level of subject. Existing teacher performance prediction model ignores this fact and misclassifies this teacher as sub-standard. Our study focuses on unbiased supervised prediction of teacher performance by identifying major unique causes of target class. RareDTree [1] algorithm take care of such unique and rare cases. It first identifies such rare and unique patterns and handles them separately so that during classification they do not get overlapped by majority instances.

# 2. Related Studies

Studies performed for teacher performance evaluation mainly of three types: (1) Student test based (2) Classroom observation and (3) Student surveys based techniques [4].

In 2013, Kane el al. [5] randomly assigns 1100 teachers across classroom located in six districts and performed classroom observation and student feedback survey. In June 2017, Andrew Bacher et al. [4] performed detailed studies to compare three types of performance evaluation studies. But in their studies they compare the performance of teacher who teaches same subject. In technological universities where particular subject teachers are of less number then this kind of studies cannot be performed.

In 2016, M. Agaoglu et. al. [3] uses different classification method to predict instructor performance. They used dataset with twenty six variable and uses C5.0, CART, SVM, ANN and DA for classification. They proved that C5.0 and CART shows best performance among other methods. But as per [2], Decision tree algorithm, SVM and other traditional classification algorithm suffer in performance for unbalanced dataset. And these algorithms ignores minority factor and biased towards majority factors.

M. Agaoglu et. al. [3] ignores variable related to the subject difficulty in the proposed studies, which is consider as vital factor for teacher performance evaluation [8].In reality each subject has different complexity level which should be taken care in evolution system. Our research define new framework which improve the framework defined in [3] by incorporating complexity level of subject.

As per Ahmed et al. [6], classification result is improved when attributes which has less impact on final outcome are removed. Authors also put course difficulties as less impact attribute but as per [4] teacher evaluation is unbiased if it

performed among the teacher who teaches same subject.

Subject difficulty need to be consider as important feature as it directly affect student's feedback to teacher [8]. As per Gunduz et al. [8] student tend to give negative feedback for difficult courses. Authors presented detailed statistical analysis of student feedback dataset collected from Gazi University in Ankara (Turkey). They considered Q10 attribute as response variable as no other class variable is provided. They also add one more response attribute called opinion which is derived using K-means clustering. But clustering is not sensitive for unbalanced data and rare class instances [1].

We performed detailed study with RareDTree [1] for the prediction of teacher performance. RareDTree is a decision tree based supervised classification algorithm designed for accurate classification of the rare class instances. Barot Pratik et al. [1], stated that the

RareDTree accurately classify the data with identification of the responsible causes for the target outcome (class). Based on the derived responsible causes, the RareDTree modifies decision tree accordingly. RareDTree shows good performance as compare to other recent algorithm of unbalanced data classification. We use RareDTree in our study by considering its performance accuracy and the unbalanced nature of teacher evaluation dataset.

# 3. Dataset

We used student feedback dataset from UCI repository which is collected from Gazi University in Ankara (Turkey). It contains 5820 responses of students and has total 33 attributes. This dataset do not have explicit class (result) attribute. We are grateful of Ahmet Rizaner et al. [6] for providing a dataset with class (result) variable. It has five class values from 1 to 5. Class values 1 and 2 are considered as bad, 3 is good and 4 & 5 are considered as very good. We add one more class labels in it. 6<sup>th</sup> class is for all

students who have less attendance and found high subject complexity.

As per Ahmet et al. [6], classification result is improved when attributes which has less impact on final outcome are removed. In turkey dataset, subject difficulty and attendance are two important attributes which together shows significance of responses. Students with less attendance are less likely gives correct feedback about teacher performance and thus such feedback should have low impact as compare to other students who regularly attend the class. As per Gunduz et al. [8], Q10 is important attribute as it indicates overall feedback of students. As per mustfaa et al. [3], C5.0 and CART classifiers determine O5, O13 and O23 as important attributes. SVM classifier selects Q22, Q23 and O25 as most important attributes. In ANN, O21 and Q23 are selected as most important feature. Authors stated that overall Q23 is proved as most important variable.

For our study three attributes: Q13, Q18 and Q23 are selected in-place of 16 attributes from Q13 to Q28. In this study we remove "Instr" attribute also because instructor identity is not important for our classification system as our aim is to build a system which can classify the teacher performance based on student's feedback.

# 4. Implementation

We have used RareDTree [1] algorithm for prediction of teacher performance. We implement RareDTree using JAVA in Weka workbench. Ten-fold cross validation is used for training and testing. Area under ROC is used for performance evaluation of RareDTree.



Figure 1: RareDTree Model for Teacher Evaluation

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RareDTree has four phases: (1) Data Preprocessing (2) Causal Relationship Extractor (3) Development of CausalTree (4) Classification using RareDTree.

First, dataset is pre-processed and attributes which are not important for our study are removed. Than after causal relationship extractor extracts causal relationship between target class and responsible patterns. Patterns which are tightly linked with target class are identified. RareDTree algorithm – A modified decision tree algorithm consider this extracted pattern and based on it additional branches are developed in decision tree. This additional branch represents that unique rare pattern which is rare and usually omitted by traditional algorithm because of its nature of assigning high priority to majority class instances. Traditional decision tree by nature ignore rare instance as it is based on information gain [11]. Because of information gain like parameters rare instances and rare classes are mostly unnoticed by decision tree algorithm [11]. RareDTree algorithm alleviates this drawback of traditional decision tree algorithm.

# 5. Results Analysis

Ahmet Rizaner et al. [6] performed classification on Turkey dataset of student feedback using J48, NB, SMO and MLP algorithm. As per the authors traditional J48 shows best result among the others algorithms. We used same dataset and applied RareDTree algorithm. Table-1 shows comparison of J48, NB, SMO and RareDTree. As shown in table RareDTree shows best performance among all other algorithms. J48 is traditional decision tree algorithm. RareDTree algorithm is improved decision tree algorithm which gives special treatment to minority instances by additional branches. In between large number of majority instances, some vital rare instance are extracted and handled effectively by the RareDTree algorithm.

 Table 1: Classification Result

Algorithm	Accuracy
J48DT	85.1%
NB	84.3
SMO	85.8
RareDTree	88.3%

Fig.2 shows performance difference of the RareDTree and other algorithms. In line of further enhancement in research study of Ahmet et al. [6], we found that modified version of decision tree algorithm (RareDTree) enhances performance of its base algorithm (J48).



**Figure 2: Performance Comparison** 

We use Oracle Database 11G express edition to analyse the relationship between less attendance, subject difficulty and bad feedback. From our sql result analysis we discover that all the instances of less attendance and difficult subject gives poor feedback for Q2,Q4,Q5,Q7,Q8,Q9,Q10,Q13,Q18 and Q23. Actually the valid feedback for these questions is only possible when instance is of moderate or good attendance [8]. With less attendance it is not possible to give proper feedback [8]. As this case is in minority number, most of the existing classification algorithms ignore this fact and result into suboptimal prediction of such teacher evaluation. Our model takes care of such minority facts with construction special CausalTree.

Another interesting pattern we discover is: there are 164 instances with highest subject difficulty level who give negative feedback. All this 164 feedbacks are from bad attendees - no one is with good attendance. This shows that if someone has bad attendance and he found difficult subject then there is highest probability that teacher evaluation get negative feedback. As this interesting pattern is in minority it remains hidden in between majority class instances. RareDTree first extracts all such interesting minority patterns and developed causal tree for them. Because of this special care it can predict such minority cases with good accuracy.

Fig. 3 shows relationship between negative feedback and attendance. Out of 1372 negative feedbacks 1127 feedbacks are from low attendee, 154 are from medium attendee and 91 feedbacks are from students with good attendance.



Figure 3: Attendance Vs Negative Feedback

# 6. Conclusion

Teacher performance evaluation among different subject teachers is biased if complexity of subject is not considered properly. To compare the performance of teachers of different subjects, student attendance and subject difficulty level should be taken care. RareDTree algorithm gives special treatment to such important minority and rare cases. Result shows improved performance as compare to past best performer of similar kind of study. Improper evaluation of good teachers lowers the quality of education system. To increase standards and quality of education system accurate classification of such cases is important and desirable. Feedbacks with lack of seriousness adversely affect the education system.

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