Prediction Of The Action Identification Levels Of Teachers Based On Organizational Commitment And Job Satisfaction By Using K-Nearest Neighbors Method

Dönüş Şengür[1,*], Muhammed Turhan[2]

[1]Ministry of Education, Şht.P. Bnb.Zafer KILIÇ Anadolu İmam Hatip Lisesi, Elazig, Turkey
[2]Department of Education, University of Firat, 23119 Elazig, Turkey
*kdksengur@gmail.com

Abstract

In this paper, the data mining techniques, which are quite hot in educational environment, are used to predict the action identification levels of the teachers. To this end, the organizational commitment and the job satisfaction levels are used as input to the data mining techniques. The well-known k-nearest neighbors (k-NN) approaches are considered due to their simple and non-parametric nature. Six different k-NN methods namely; fine, medium, coarse, cosine, cubic and weighted k-NN are considered and the obtained results are evaluated based on the prediction accuracy score. A dataset, which covers both organizational commitment and the job satisfaction levels of the teachers, is collected from 126 teachers. Extensive experimental studies are carried out with 5-fold cross validation test in MATLAB environment and the obtained results are recorded accordingly. The obtained results show that the proposed scheme is quite successful in prediction of the action identification levels. Especially, for some of the action identification levels, the obtained accuracy scores are 88.1%, 89.7% and 93.6%, respectively which show the success of the proposed idea.

Keywords: Data mining, k-nearest neighbors, organization commitment, job satisfaction, action identification levels.

Öğretmenlerin Örgütsel Bağlılık Ve İş Doyumuna Dayalı Eylem Kimlikleme Düzeylerinin K-En Yakın Komşular Yöntemi Kullanılarak Tahmin Edilmesi

Özet

Bu çalışmada, eğitim alanında oldukça sık kullanılan veri madenciliği teknikleri, öğretmenlerin eylem kimlikleme düzeylerinin tahmininde kullanılmıştır. Bu amaçla, örgütsel bağlılık ve iş doyumu düzeyleri veri madenciliği tekniklerine girdi olarak verilmiştir. Basit ve parametrik olmayan yapıları nedeniyle iyi bilinen k-en yakın komşular (k-EYK) yaklaşımlarının kullanılması düşünülmüştür. İsimleri sırasıyla; ince, orta, kaba, kosinüs, kübik ve ağırlıklandırılmış k-EYK olan altı farklı k-EYK yöntemleri kullanılmıştır ve elde edilen sonuçlar tahmin edilen doğruluk değerlerine göre değerlendirilmiştir. Öğretmenlerin hem örgütsel bağlılık hem de iş doyumu düzeylerini kapsayan bir veri seti, 126 öğretmenden oluşturulmuştur. Kapsamlı deneysel çalışmalar MATLAB programında 5-katlı çapraz geçerlilik testi ile gerçekleştirilmiştir ve elde edilen sonuçlar buna göre kaydedilmiştir. Elde edilen sonuçlar, önerilen yöntemin eylem kimlikleme düzeylerinin belirlenmesinde oldukça başarılı olduğunu göstermektedir. Özellikle bazı eylem kimlikleme düzeylerinde, elde edilen doğruluk değerleri sırasıyla; %88,1, %89,7 ve %93,6'dır ki, bu önerilen fikrin ne kadar başarılı olduğunun bir göstergesidir.

Anahtar Kelimeler: Veri madenciliği, k-en yakın komşular, örgütsel bağlılık, iş doyumu, eylem kimlikleme düzeyleri.

1. Introduction

Organizational commitment is defined as to desire to remain in the organization declared by the employee [1], loyalty and tight commitment [2], belief in the organization's purpose and retention level [3]. It is difficult for an administrator to be successful in an organization where the employees' organizational commitment is low. In the definition made by Meyer and Allen [4], organizational commitment was defined as the continuation of the work in a

stable manner, the ownership and integration of the values of the workplace. The organizational commitment, as seen in these definitions, is to show the worker the positive and satisfying attitudes displayed at the workplace and the desire to stay with satisfaction [5].

Job satisfaction is related to general attitudes towards work. Persons with high levels of satisfaction usually exhibit a positive attitude, while insatiable people often show negative attitudes toward life [6]. Job satisfaction is also a part of life satisfaction; it can be said that individuals who are satisfied with their job are happier in their lives [7]. Briefly, the job satisfaction makes the employee feel happy about the work [8].

Researches show that organizational commitment and job satisfaction are related to employees' emotions, attitudes and behaviours in the workplace. According to research findings; job satisfaction is positively associated with performance [9], job involvement [10] and motivation [11] while negative associated with turnover intention [12], stress [13] and burnout [14]. Likewise, organizational commitment is positively associated with positive attitudes and behaviours [15-17] and negatively associated with negative attitudes and behaviours [18-20]. Strong relationships between organizational commitment and job satisfaction and positive and negative job attitudes and behaviours suggest that commitment and satisfaction levels are closely related to the manner in which employees perceive the behaviours they exhibit at work.

The theory of action identification argues that any action can be mentally represented or identified in many different ways [21-23]. The theory provides information on how people conceptualize their actions and how they affect action and the emergence of new behaviours [24]. The aim of the theory is to explain the nature and functioning of the bridge between thought and behaviour. At the hierarchical levels, the upper and lower level identities are different from each other in terms of their scope and structure. High-level identities that abstract long-term strategic plans, while responding to the "why" question; low-level identities that explain direct actions and bodily movements respond to "how" [22, 23].

The way that actions are identified is also very important in terms of teaching profession. It can be said that a teacher who feels happy in his/her work will be more committed to school and will endeavour to do his/her job properly [25]. For this reason, it is very important to determine how teachers identify the actions that they perform. However, it is difficult to directly measure the way of teachers identify their actions. Researchers hypothesize that teachers' levels of action identification can be predicted using variables such as job satisfaction and organizational commitment.

Data mining is a convenient way to extract important knowledge from a given raw data for various purposes [26]. Educational domain is one of the leading areas where lots of studies have been conducted with data mining approaches [27]. Prediction and/or modelling of various quantities related with education can help to develop better educational environments for students, teachers and administrators. Various quantities such as grades, demographic, social and school related features have been used in data mining applications. The studies, which have been carried out so far, are generally related with student's performance prediction [28]. As the related literature is examined, it is seen that the general trend of educational data mining has been on students' performance prediction. Different from the previous studies, in this study, the action identification levels of teachers are predicted based on their organizational commitment and job satisfaction levels. The k-nearest neighbors (k-NN) method which is known to be the easy implemented, effective, and non-parametric classification approach is considered [29]. Six different k-NN approaches are used in the experimental studies on a dataset that was collected from 126 teachers. The dataset contains 14 quantities that are acquired from organizational commitment and job satisfaction questionnaires. There are also 11 action identification items that are used independently. Various experimental studies are conducted to validate the proposed approach and the obtained results show k-NN approach is quite efficient in determining the action identification levels of the teachers based on their organization commitment and job satisfaction levels.

The organization of the paper is as following. Next section briefly introduces the details about data collection and k-NN approach. In Section 3, the experimental setup and the obtained results are given. Finally, we conclude the paper in Section 4.

2. Materials and Methods

This section briefly reviews the dataset collection and the k-NN theory. The reader may refer to [29] for more details about the k-NN approach.

2.1. Dataset collection

In order to determine the relationship between teachers' level of action identification and organizational commitment, a data was collected from 127 teachers working in the province of Elazig in the academic year 2014-2015 by using the method of disproportionate stratified sampling. 64 (50.4%) of the 127 participants were male and 63 (49.6 %) of the 127 participants were female. 98 (77.2%) of the participants were married, and 29 (22.8%) of them were single; 23 (18.1%) were class and 104 (81.9%) were branch teachers. The ages of participants were ranged from 23 to 62 and the average age was 36.3.

The Action Identification Form developed by Turhan and Sengur [30] and Organizational Commitment Scale developed by Meyer and Allen [31] and adapted to Turkish by Wasti [32] were used to collect the data. The Organizational Commitment Scale was a 5-Likert type and the scale in which validity and reliability studies were performed by Basol and Yalcin [33], was used as a short form with 9 items selected by paying attention to the scope validity. In addition, the internal consistency coefficient of the scale for this study was calculated as 0.784.

2.2. k-Nearest neighbors approach

Data mining, which covers a dozens of classification and regression techniques, aims to extract valuable knowledge from a given raw dataset. This can be done by either supervised or unsupervised. In supervised classification, a set of labelled dataset is used for mining some rules that connect the input dataset to labels. As it was mentioned earlier, k-NN is one of the simplest, easy-implemented, non-parametric and supervised data classification techniques. k-NN uses a distance function to calculate the similarities between test samples and the training samples. The labels of the test samples are then determined by majority voting procedure. Each test sample label is determined by the labels of its k nearest training samples which have high similarity with that test sample. k-NN approach uses Euclidean, Mahalanobis, Hamming and Minkowski distances for distance function.

3. Experimental Studies and Results

In this study, a dataset, which was collected from 126 teachers, is used to validate the proposed idea. The dataset contains 14 items where 9 of them come from the organizational commitment questionnaires and the rest of the items are from the job satisfaction questionnaires. As it was mentioned earlier, the organizational commitment and job satisfaction of teachers are used to determine their action identification levels. There are also 11 action identification items that are used independently. The action identification levels are given in the appendix.

k-NN method generally has high predictive accuracy in low dimensions. This situation can be seen as an advantage of the k-NN method. High memory usage, and not easy to interpret properties make k-NN method disadvantageous. In this study, six different k-NN methods are used that are in the classification learner application of the MATLAB. These approaches are fine, medium, coarse, cosine, cubic and weighted k-NN, respectively. In fine k-NN approach, the number of neighbor k is chosen as 1.

In addition, for medium and coarse k-NN approaches, the numbers of neighbors are selected as 10 and 100, respectively. In cosine and cubic k-NN approaches, the cosine and cubic distance metrics are used and the numbers of the neighbors are set to 10. In weighted k-NN, the number of neighbors is also set to 10 and a weighted distance function is used for class separation.

The obtained results are evaluated with mean accuracy score where 5-fold cross validation test is applied. Accuracy is defined as the ratio of the correct predictions to the total number of evaluated cases. As there are 11 action identification levels, the experiments are conducted for each action identification level and the results are given in Tables 1 to 11.

Table 1. The prediction results for the first action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	65.9
	Medium k-NN	**77.8**
	Coarse k-NN	77.0
	Cosine k-NN	73.8
	Cubic k-NN	76.2
	Weighted k-NN	73.8

Table 1 shows the obtained results for the first action identification level. As seen in Table 1, medium k-NN approach produces the best accuracy score where it is 77.8%. The second best accuracy 77.0% is yielded by coarse k-NN technique. Fine k-NN approach produces the worst accuracy where its score is 65.9%.

Table 2. The prediction results for the second action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	80.2
	Medium k-NN	**88.9**
	Coarse k-NN	**88.9**
	Cosine k-NN	88.1
	Cubic k-NN	**88.9**
	Weighted k-NN	88.1

The prediction performances for the second action identification level are given in Table 2. As seen in Table 2, medium, coarse and cubic k-NN approaches obtain the 88.9% accuracy scores which are the highest among all k-NN techniques. 80.2% accuracy score is produced by fine k-NN which is the worst one and cosine and weighted k-NN techniques obtain the 88.1% accuracy scores.

Table 3. The prediction results for the third action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	59.5
	Medium k-NN	73.0
	Coarse k-NN	**74.6**
	Cosine k-NN	68.8
	Cubic k-NN	72.2
	Weighted k-NN	69.8

Coarse k-NN approach produces the 74.6% accuracy score which the best one for the third action identification level as shown in Table 3. The second best accuracy 72.2% is produced by cubic k-NN method. Fine k-NN produces the 59.5% accuracy score which is again the worst one. Cosine and weighted k-NN techniques produce almost similar accuracy score where the recorded accuracy scores are 68.8% and 69.8%, respectively.

Table 4. The prediction results for the fourth action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	79.4
	Medium k-NN	**89.7**
	Coarse k-NN	**89.7**
	Cosine k-NN	**89.7**
	Cubic k-NN	**89.7**
	Weighted k-NN	**89.7**

Except fine k-NN approach, all k-NN methods produce 89.7% accuracy score for the fourth action identification level as tabulated in Table 4. The fine k-NN yields 79.4% accuracy score.

Table 5. The prediction results for the fifth action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	62.7
	Medium k-NN	71.4
	Coarse k-NN	71.4
	Cosine k-NN	73.8
	Cubic k-NN	71.4
	Weighted k-NN	**74.6**

The prediction scores for the fifth action identification level are given in Table 5. As seen in Table 5, the weighted k-NN method obtains 74.6% accuracy score which is the best and fine k-NN approach produces 62.7% accuracy score which the worst one. Medium, coarse and cubic k-NN methods produce 71.4% accuracy scores and cosine k-NN yields the 73.8% accuracy value.

Table 6. The prediction results for the sixth action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	88.9
	Medium k-NN	**93.7**
	Coarse k-NN	**93.7**
	Cosine k-NN	**93.7**
	Cubic k-NN	**93.7**
	Weighted k-NN	92.9

Table 6 shows the obtained results for the sixth action identification level. As seen in Table 6, medium, coarse, cosine and cubic k-NN methods obtain the 93.7% accuracy scores. This value is the highest prediction score in all action identification levels. Weighted and fine k-NN methods produce 92.9% and 88.9% scores, respectively.

Table 7. The prediction results for the seventh action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	69.8
	Medium k-NN	79.4
	Coarse k-NN	**81.0**
	Cosine k-NN	**81.0**
	Cubic k-NN	79.4
	Weighted k-NN	79.4

The obtained results for the seventh action identification level are given in Table 7. Coarse and cosine k-NN approaches obtain the 81.0% accuracy scores which are the best one for this level. Medium, cubic and weighted k-NN methods produce 79.4% accuracy, respectively. The worst accuracy is also produced by fine k-NN method.

Table 8. The prediction results for the eighth action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	58.7
	Medium k-NN	**66.7**
	Coarse k-NN	65.9
	Cosine k-NN	62.7
	Cubic k-NN	64.3
	Weighted k-NN	62.7

The prediction results for the eighth action identification level are shown in Table 8. As can be seen, the medium k-NN approach produces 66.7% accuracy score which is the highest one. Coarse k-NN method produces 65.9% score which is the second best one. Cosine and weighted k-NN methods achievements are identical where 62.7% accuracy scores are recorded. The worst accuracy 58.7% is also obtained by fine k-NN.

Table 9. The prediction results for the ninth action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	58.7
	Medium k-NN	**66.7**
	Coarse k-NN	65.9
	Cosine k-NN	62.7
	Cubic k-NN	64.3
	Weighted k-NN	62.7

Medium k-NN approach produces 66.7% achievement score which is the best accuracy for the ninth action identification level as seen in Table 9. Coarse and cubic k-NN techniques produce the second and third best achievements, respectively. Cosine and weighted k-NN techniques yield the 62.7% accuracy scores. The worst accuracy 58.7% is obtained by fine k-NN method.

Table 10. The prediction results for the tenth action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	**Fine k-NN**	**58.7**
	Medium k-NN	51.6
	Coarse k-NN	31.7
	Cosine k-NN	49.2
	Cubic k-NN	44.4
	Weighted k-NN	55.6

As seen in Table 10, the fine k-NN approach produces the 58.7% best accuracy score for the tenth action identification level. This is quite surprising because for all other action identification levels, the fine k-NN approach produce the worst results. Coarse k-NN method produces the worst accuracy 31.7% for the tenth action identification level.

Table 11. The prediction results for the eleventh action identification level. The bold case shows the best accuracy.

Method	Classifier Type	Accuracy (%)
k-NN	Fine k-NN	73.8
	Medium k-NN	**84.1**
	Coarse k-NN	**84.1**
	Cosine k-NN	**84.1**
	Cubic k-NN	**84.1**
	Weighted k-NN	83.3

Finally the obtained results for the eleventh action identification level are tabulated in Table 11. Medium, coarse, cosine and cubic k-NN classifiers produce the same best achievements where their scores are 84.1%. Weighted and fine k-NN methods obtain the 83.3% and 73.8% scores, respectively.

4. Conclusions

In this paper, the action identification levels of the teachers are predicted based on their Organizational commitment and job satisfaction levels. The prediction is carried out with the popular k-NN methods. The dataset is collected from 126 teachers where 14 quantities and 11 action identification levels are used in the experimental works. In the experimental works 14 quantities are used as inputs and each action identification level is used as output. Thus, the experiments are repeated 11 times. From obtained results, it is seen that the best prediction is carried out for sixth action identification level and the worst accuracies are recorded for tenth action identification level. Generally speaking, the fine k-NN approach produces the worst accuracy scores and medium k-NN method generally produces the best accuracy scores. The obtained results also show that the data mining can be used as a convenient tool for action identification level determination.

5. References

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Appendix

The action identification levels	
1. To read and sign written orders	□ To be informed about developments and decisions about our profession □ Signing the part of me that I left on the signature circle.
2. Performing the guard duty	□ Providing school security and contributing to making the school a healthy environment from every angle □ Waiting on guard
3. The teachers' board, which is held during the year, participates in the meetings of the group teachers' board.	□ To discuss professional issues in the courts and to make decisions. □ Sitting at the meeting place
4. Participation in parents' meetings	□ Cooperating with the parents for the student □ Being in school during the meeting
5. To attend official ceremonies (October 29, November 10, etc.)	□ Work to ensure that students are aware of national days. □ Waiting at the ceremony and performing the procedure.
6. Using tools in the classroom and laboratory courses	□ To support the lesson with materials to make the course more productive. □ To perform the specified events on the annual plan.
7. Teacher's job as branch guide teacher (classroom teacher)	□ Cooperating with other teachers, parents and school guidance teachers for students □ Perform formal actions for the class
8. vocational studies conducted throughout the year (such as preparation of seminar topics given at the end of the year)	□ To contribute to education-teaching activities □ To fulfill administrative obligations on paper
9. Duties given in social activities (Social club and community service studies)	□ To overcome the awareness of taking part in the work that will benefit the student, gathering. □ Prepare the documents required by the school administration for social activities
10. Evaluating the students with point	□ Digitize the situation so that the learner can evaluate himself / herself and the learner □ Scoring as specified in the curriculum
11. Teaching	□ Building the future of students □ telling the students the lessons in the curriculum