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Dropout Detection Using Non-Academic Data

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Abstract—The common problem in the university is the high dropout rate. The high dropout rate will have a bad impact on the university. Various studies have tried to determine the factors that influence the dropout. Almost all research focuses on academic factors of students as a determinant of potential dropouts. However, there are sometimes cases of dropout students who cannot be determined using academic factors. This raises the hypothesis that the potential dropout students can be determined from non-academic factors. There are 5 non-academic factors criteria that can be used as determinants of dropout, demography, social interaction, finance, motivation, and personal. These criteria give rise to 37 factors that are considered influential in determining the potential dropout. The factors processed into three phases are collecting data, preprocessing data, and modelling. The factor that are independent to other factors are the number of family, the interest in the future study, and the relationship with the lecturer. Based on the result of correlation test there are two factors had correlation, so the modelling done with two combination factors. The best model is using combination of factor the number of family and the relationship with the lecturer using Decision Tree with split criterion is Maximum Deviance Reduction and maximum split is 2 with time for training is 1.7386 seconds.

Keywords— Classification, Decision Tree, Dropout Detection, Education data mining, non-academics

I. INTRODUCTION

Dropout was common education issues that need an attention. High rate of dropout can have bad impact to the university [1]. The high number of dropout make many researchers attempt to find the best influencing factors. They use data mining method to modelling the dropout, so it called education data mining [2]. The dropout can be influenced by many factors from academic [3]. The academic factors that mostly used are course scores, the number of student present in course [4], and the achievement. The course scores that used [5] are English, Mathematics, Physics, Chemistry, Computer Science, and Reading and Writing scores. However, sometimes dropout cases cannot be determined only using the academic factors. There are non-academic factors can be influenced the student to dropout [3].

The dropout can be influenced by the demographics, the financial, the motivation, the social interaction, and the personality. Demographics is a factor that can describe the characteristics of individuals [6], such as gender, distance of residence, and employment status. Feature contained in the individual can describe the pattern that classify individuals into groups.

Personal motivation for the study may affect the achievement in the study. Bad motivation [7] is often the case in such studies

student who not interested with the selected majors. Financial factors [8] are also a factor that influencing the graduation. Sometimes the outstanding students failed to complete his studies because the student must spend more time for working time, or financial of the family that do not allow the student to continue his studies.

The dropout [9] can be influenced by the personality of the student. The student can be grouped to the 6 types personality that can be grouped by “Holland Personality Type Theory”. There are correlations of the personality and the course, so if the student not have the match personality with the majors it can be high potentially to dropout. In the other study [10], medical student grouped using the “Edwards Personal Preferences” (EPPS) into personality A, B, and AB. The personality linked to the academic achievement using chi square test and was found that the personality A has a higher probability to achieve high academic achievement than personality B and personality B has a higher probability than personality AB.

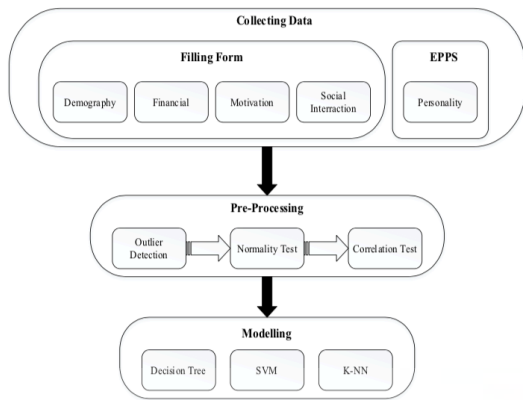
Every individual has a different personality [9][10]. Personality determines the probability of success of students in education. The outstanding students in the academic field is students who score high on the personality of the personality scale of Achievement, Order, Exhibition, Autonomy, Dominance, Endurance, and aggression. Each major also formed a different personality. For examples in medical majors, students who study in the medical field are required to have a value scale on the value of personality Achievement, Order, Autonomy, Affiliation, Endurance, Nurturance, Change, and Heterosexuality.

According to the previous studies, this study analyzing the best non-academic factors that can influence the student graduation and make a model to predict the student graduation with high accuracy. We use well known classification method are Decision Tree, SVM, and K-NN to find the best accuracy of the model.

II. METHODOLOGY

This study was involved by 3 phases (see Figure 1). The first phase goal is collecting data that done with 2 collecting method are form and Psychological measuring instrument using Edward Personal Preferences Schedules (EPPS). The second phase goal is preprocessing the data that done by 3 preprocessing methods are Outlier Detection, Normality Test, and Correlation Test. The last phase goal is modelling the best factors using Decision Tree, SVM, and K-NN to find the best accuracy model.

Fig. 1. Flowchart of proposed work



A. Collecting Data

This study collecting the data from student which study in several universities in Indonesia using simple random sampling. Data taken by survey that using 2 methods. In the first method, the respondent filling the form about the demography, motivation, financial, and social interaction of himself (see Table 1). In the second method, the respondents take the EPPS test to get the personality factors. EPPS forced respondent to choose a pair of statement that reflect himself. EPPS have 225 pair of statement and return the 16 personality factors.

TABLE I. THE NON-ACADEMIC FACTORS THAT PROPOSED TO PREDICT THE STUDENT GRADUATION

Category	Factor
Demography	Gender
	Home Distance
	Living Status
	Marital Status
	Number of Family Member
	Waiting Time to Study
	Internet in The House
	Intensity of use the mobile phone
Motivation	Health
	Interest in further study
	Interest in the majors
	Study motivation
Financial	Suitability expectation to the majors
	Employment Status
	Mother's Education
	Mother's Employment Status
Social Interaction	Father's Education
	Father's Employment Status
	Relationship with students
Personality	Relationship with Family
	Relationship with Lecturers
	Achievement
	Deference
	Order
	Exhibition
	Autonomy
	Affiliation
	Intracception
	Succorance
	Dominance
	Abasement
	Nurturance
	Change

	Endurance
	Heterosexuality
	Aggression
	Consistent

B. Preprocessing

1) Outlier Detection

The dataset screened using the Inter quartile range (IQR) to detect the outlier. The data that have the IQR value less than lower bound or upper bound will be labeled as outlier, but the result will be examined to keep the information of data.

2) Normality Test

The data tested about normal distribution using the Kolmogorov-Smirnov method. Test was do using the SPSS. The dataset is normal distributed when the output of the method is greater than 0.05. The result plotted to the Regression Standardized Residual Plot that has a diagonal line with each error data position to show the dataset was normal distributed or not.

3) Correlation Test

The data will be tested using the correlation test to get the relation for each pair of factors. Those values will be counted the frequencies of the data. The results of frequency analysis then be analyzed with the data class. The analysis aims to make a hypothesis about the influence factor to the class. To ensure that hypothesis, an inferential analysis will be performed using Pearson Correlation method to obtain a correlation coefficient of the factors to the data class. The factors can be expressed as correlated if it has the Pearson correlation coefficient greater than the value of the correlation coefficient table.

Factors that have no correlation to the data class will not be used at the next phase. The factors which have correlation with the class then tested the correlation to other factors. Good factors are the factor that have a correlation with the data class and not have correlation with the other factors.

C. Dropout Modelling

The factors that passed the previous stages will be used on the model. These factors will be used in the experiment using 3 classification methods are Decision Tree, Support Vector Machine, and K-NN. Each of these methods will be varied the parameters. Decision Tree method will be varied the split criterion and the maximum split. SVM method will be varied the parameters constraint box and kernel scale. The K-NN will be varied the Distance Metric method and the Distance Weight.

III. RESULT AND ANALYST

A. Collecting and Preprocessing Dataset

The dataset obtained amounted to 103 samples. Data collected using simple random sampling method. There are 9 data were categorized as outliers. Data were categorized as outliers are removed from the dataset. The dataset is then tested using Kolmogorov Smirnov method to determine whether the data were normally distributed or not. The output of the test is 0.200 were that value is greater than 0.05, so the dataset is normal distributed.

B. Data Analyst

In this section, each factor will be analyzed using frequency method and tested inferentially to obtain the correlation between the factors and classes. The factors that have the correlation are have correlation coefficient higher than 0.2028 (based on coefficient table with number of data is 94 and 2 tailed significant 5%). Based on the result of the analysis, the good factors are number of family, interest in further study, and relationship with the lecturer.

1) Number of Family

TABLE II. FREQUENCY ANALYSIS BETWEEN NUMBER OF FAMILY AND GRADUATION

Number of Family	Frequency	Graduated (%)	Dropout (%)
3	10	90	10
4	42	64.29	35.71
5	29	51.72	48.28
6	6	50	50
7	4	50	50
8	2	50	50
9	1	0	100

Based on the results of frequency analysis (see Table II) obtained 7 statements of respondents to the number of family members are 3, 4, 5, 6, 7, 8, and 9 family members. On the number of family members 3 by 10 respondents, the graduation rate of 90% and dropout rate of 10%. On the number of family members 4 by 42 respondents, the graduation rate of 64.29% and dropout rate of 35.71%. On the number of family members 5 by 29 respondents, the graduation rate of 51.72% and dropout rate of 48.28%. On the number of family members 6 by 6 respondents, the graduation rate by 50% and dropout rate of 50%. On the number of family members 7 by 4 respondents, the graduation rate by 50% and dropout at 50%. On the number of family members 8 by 2 respondents, the graduation rate by 50% and dropout rate of 50%. At number family 9 by 1 respondent, the graduation rate of 0% and dropout rate of 100%. Results of the analysis showed significant differences between the number of family members is less than equal to five and more than 5, so there is influence between the number of family members and graduation. This is also ensured by the Pearson correlation test that gives coefficient correlation of -0.228. The minus sign on the correlation coefficient means that the smaller number of families give more chance to respondent to graduated and the value of 0.228 indicates a weak correlation bond.

2) Interest in The Further Study

TABLE III. FREQUENCY ANALYSIS BETWEEN INTEREST IN FURTHER STUDY AND GRADUATION

Interest in Further Study	Frequency	Graduated (%)	Dropout (%)
No	25	40	60
Yes	69	68,12	31.88

Frequency analysis results (see Table III) showed that there were 69 respondents who expressed interest for further studies, while 25 respondents expressed no interest in the further study. If the variable of interest in further study analyzed with the graduation, the group of respondents who expressed interest in

further study has a graduation rate of 68.12%, while the dropout rate of 31.88%. At respondents expressed no interest in further studies, the graduation rate of 40% and the dropout rate of 60%. The results showed that the group of respondents who have interest in further study had a higher graduation rate than the group of respondents who are not interested in further studies. The group of respondents who have no interest in further studies showed the dropout rate is greater than the graduation rate. The percentage given by the two groups look very contrasting and show that there are significant differences between the two groups. The same result was shown by the test results of Pearson correlation, correlation coefficient values were obtained for 0.254. That value indicates a weak correlation.

3) The Relationship with Lecturers

TABLE IV. FREQUENCY ANALYSIS BETWEEN RELATIONSHIP WITH LECTURERS AND GRADUATION

Relationship with The Lecturer	Frequency	Graduation (%)	Dropout (%)
Bad	0	0	0
Normal	7	14,29	85,71
Good	87	64,37	35,63

The results of frequency analysis (see Table IV) showed that there were no respondents who said the relationship with the lecturer is bad. The respondent who said that his relationship with the lecturer is normal there are 7 people. The graduation rate in normal relation with lecturer of 14.29%, while the dropout rate of 85.71%. Respondents who expressed have a good relationship with the lecturer is 87 respondents. The graduation rates in the group of respondents with good relations lecturer of 64.37%, while the drop-out rate of 35.63%. These values showed significant differences in the two groups of respondents. The group of respondents with a normal relationship demonstrates the potential to dropout, while the group with good relations show potential to graduation. The results of this analysis showed a significant difference between the 2 groups. The correlation coefficient obtained by Pearson correlation test of 0.269. The results showed that the respondents who have a good relationship with the lecturer have the greater potential to graduation, that value also indicate the weak correlation between variables relationship with lecturer and graduation.

These three factors are then tested the correlation between factors. Testing the correlation between factors performed using Pearson correlation. Correlation test results showed that there is a correlation between the factor of interest in further study and relationship with the lecturer, while the factor of the number of family members have no correlation with other factors. Based on the result this research can be formed into two combined factors to form models that predict graduation. The first combination is a combination of factors the number of family members and the interest of further study. The seconds combination is a combination of factors the number of family members and the relations of lecturers.

C. Modelling

TABLE V. COMPARISON OF EXPERIMENTAL RESULTS

Combination Factors	Method	Accuracy (%)	Time (s)
Combination 1	Decision Tree	66	1.9724
	SVM	66	1.7884
	KNN	56.40	-
Combination 2	Decision Tree	66	1.7142
	SVM	66	1.7386
	KNN	53.20	-

Combination 1 = the number of family + the interest of further study

Combination 2 = the number of family member + the relation of lecturers

The combination of these factors used in the experiment using Decision Tree, SVM, and K-NN. The result of the experiments shown on Table V. On a combination of the number of family members and the interest of further studies (combination 1) using the Decision Tree, the highest accuracy rate and the lowest time required to train obtained on the use of Maximum Deviance Reduction and maximum split is 2. The level of accuracy obtained by 66% by the time needed for 1.9724 seconds. On the use of SVM classification method, get the highest level of accuracy in the use value of the constraint box with a value level 2 and kernel scale is 2. The accuracy rate of 66% and the time needed to train the method for 1.7884 seconds. On the use of K-NN method, the level of accuracy obtained only reached 56.40%, the accuracy rate is much different when compared with the two other methods. Based on the experimental results, the best model for the combination of factor on the number of family members and the interest of further studies is using SVM classification method with the value of the constraint box 2 and the kernel scale is 2 because this model requires a shorter time than the Decision Tree method.

On a combination of the number of family members and relationship with lecturers (combination 2) using Decision Tree, the highest level of accuracy and the time required to train obtained on the use of split criterion Maximum Deviance Reduction and maximum split is 2. The accuracy rate of 66% by the time to training for 1.7142 seconds. On the use of SVM classification method, the highest level of accuracy in the use of box constraint value level 3 with the kernel scale is 2. The level of accuracy of 66% and the time needed to train the method for 1.7386 seconds. On the use of K-NN method, the level of accuracy obtained only reached 53.20%, the accuracy rate is low when compared with the two other methods. Based on the experimental results, the best model is combinations of the number of family members and relations of lecturers using Decision Tree classification method and split criterion method is Maximum Deviance Reduction and maximum split is 2 because it required a shorter time than the SVM method.

IV. CONCLUSION

The Factors that influenced the graduation of students are the number of family member, interest in the further studies, and relationship with the lecturers. Students which have number of family member bigger than 5 potentially to potentially to dropout, while the student which have the number of family member lower than and equal to 5 potentially to graduated.

The students which have interest in further study potentially to graduation, while the students which have no interest in further study potentially to dropout. The students which have normal or bad relationship potentially to dropout, while the students which have good relationship potentially to graduation.

Graduation of the students can be predicted by using 2 kind of combinations factor. The first combination factor is the number of family member and the interest in further study. The second combination factor is the number of family member and the relationship with the lecturers. The best model is the model that used second combination factor with Decision Tree method using split criterion is Maximum Deviance Reduction and maximum split is 2 with time for training is 1.7386 seconds. For the better result researcher can combine the non-academic factors and academic factors.

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