

Machine learning approach to air traffic control skill based on mastery theory of aerodrome control procedures, self-concept and practice drills

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Abstract. The objectives of the research were to discover the correlation of mastery theory of aerodrome control procedures toward the skill of air traffic control, self-concept toward the skill of air traffic control, frequency of drills toward the skill of air traffic control and correlation of mastery theory of aerodrome control procedures, self-concept and frequency of drills toward the skill of air traffic control. The population consisted of 105 students and 50 students were taken as the sample through cluster random sampling technique. The results of the research concluded, there was a significantly positive correlation between mastery theory of aerodrome control procedures and skill of air traffic control as shown by coefficient correlation 0.6648, there was a significant positive correlation between self-concept and skill of air traffic control as shown by coefficient correlation 0.5825, there was significant positive correlation between frequency of drills and skill of air traffic control as shown by coefficient correlation 0.4159 and there was significant positive correlation of mastery theory of aerodrome control procedures, self-concept, frequency of drills toward the skill of air traffic control as shown by multiple coefficient correlation 0.740. Determination coefficient of multiple correlations was 0.5478 or 54.78% showed that mastery theory of aerodrome control procedures, self-concept, frequency of drills gave impact on skill of air traffic control.

1. Introduction

Professional Air Traffic Controllers are produced through the Education and Training Institute under the regulation of the Ministry of Transportation which is responsible to conduct Air Traffic Control education and training. Indonesia Civil Aviation Institute (STPI) and Civil Aviation Safety and Engineering Academy of Medan (ATKP) are Education and Training Institute under the regulation the Ministry of Transportation having the responsibility to prepare professional personnel in aviation safety and engineering. The competencies required above are given through theoretical learning in the classroom [1], especially in the expertise subjects, one of which plays a role is the Aerodrome Control Procedures. Meanwhile, the competency of air traffic control skills is given through air traffic simulation at the Aerodrome Control Tower laboratory.

In this study, we use control-mastery theory of aerodrome procedure as cognitive ability factor, self-concept as a broad and flexible self-concept and practice drills as the act [2] to increase the knowledge by using machine learning approach.

From the data obtained, the minimum level of mastery of cadets is caused by several things such as lack of preparation, lack of mastery of procedures, lack of clear concepts, lack

of focus, lack of confidence and frequent nervousness when facing air traffic simulation in the learning process. This study aims to find out how the level of mastery of the theory of aerodrome control procedures, self-concept and the frequency of drills become very important variables to study.

2. Data and Method

2.1 Data

This research was conducted at the Indonesia Civil Aviation Institute (STPI) and Civil Aviation Safety and Engineering Academy of Medan (ATKP). The population in this study was all cadets of Diploma II and III Air Traffic Control at Indonesia Civil Aviation Institute and Civil Aviation Safety and Engineering Academy of Medan, which totaled 105 people. The characteristic of correlational research is that the study does not require a large number of sample. According to [3], [4] 50 to 100 research samples are sufficient. If the researcher will generalize the results of his research, then he must succeed in taking a sample that is truly representative. From the total population, the sample of the study was 50 people taken using the cluster random sampling technique, namely 27 cadets of Indonesia Civil Aviation Institute and 23 cadets of Civil Aviation Safety and Engineering Academy of Medan (ATKP).

2.2 Method

The research method is conducted with machine learning techniques [5] by using a regression model to determine the coefficients between mastery theory [1], [2], [6]–[8] of aerodrome control procedures (X1), self-concept [3], [8] (X2) and frequency of drill [2], [9], [10] (X3) as independent variables and skill of air traffic control as a dependent variable (Y). Regression model [4], [11] will measure data provide to find correlations between factors in data to find out what most affects the bottom line. Correlational research is a study that is intended to determine whether there is a correlation between two or several variables. With correlation machine learning techniques, the author can find out the correlation of variation in a variable with other variations. The result of the correlation is expressed in the form of a correlation coefficient. Furthermore, correlation techniques are used to determine the correlation of each independent variable to the dependent variable and the correlation of the independent variable together with the dependent variable. In a descriptive study [4], [9], the correlation coefficient explains the extent to which two or more variables are correlated, whereas in the research generalizing the hypothesis the correlation coefficient shows the level of significance of whether or not the hypothesis is proven.

3. Result and Discussions

The results of this study are accordance and represented of the calculation of simple regression analysis on the first hypothesis proposed to the variable of mastery theory of aerodrome control procedures (X1) and air traffic control skill variable (Y) were indicated by the regression line equation $\hat{Y} = 58,385 + 0.5238X1$. These results indicated that an increase in one mastery score in the theory of aerodrome control procedures led to an increase of 0.5238 scores in air traffic control skill at constant 58,385. In other words, each score of mastery of the aerodrome control procedures theory increases by 1, then the average score of the skill of air traffic control will increase by 0.5238.

The results of the calculation of simple regression analysis on the second hypothesis proposed for the self-concept variable (X2) and air traffic control skill variable (Y) was indicated by the regression line equation $\hat{Y} = 35.3398 + 0.1673X2$. The results indicated that an increase in

one self-concept score caused an increase of 0.1673 scores in air traffic control skill on the constant 35.3398. In other words, if each self-concept score increased by 1, then the average score of air traffic control skill would increase by 0.1673.

The result of the correlation between self-concept and the skill of air traffic control was shown in fig.1 by the product moment correlation coefficient of $r_{y2} = 0.5825$ and the coefficient of significance test with t-test obtained by the value of count = 4.9652. The value of t-table and dk = 48 and significance level is 0.05 was 2.01. The t-count = 4.9652 > t table = 2.01 it can be said that the correlation between self-concept and skill of air traffic control was significant. This finding concluded that H0 was rejected and H1 accepted. Therefore, the test of the second hypothesis concluded that "there was a significant positive correlation between self-concept and the skill of air traffic control"

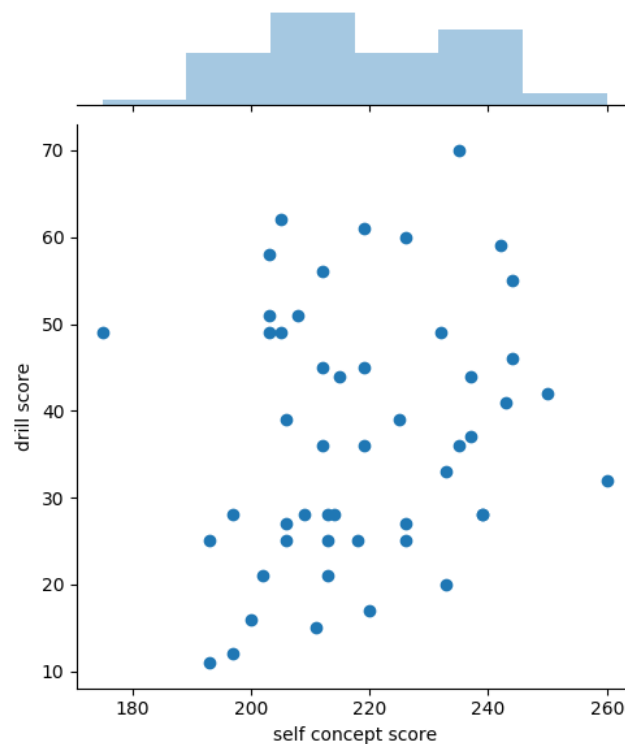


Figure 1. Correlation Self Concept to practice drills

The result of the correlation between mastery of the theory of aerodrome control procedures and the skill of air traffic control was shown by the product moment correlation coefficient of $r_{y1} = 0.6648$ and the coefficient of significance test with t-test obtained by the value of count = 6.165. The value of t-table and dk = 48 and significance level is 0.05 was 2.01. The t-count = 6.165 > t-table = 2.01 it can be said that the correlation between the mastery of the theory of aerodrome control procedures and the skills of air traffic control was significant. This finding concluded that H0 was rejected, in other words, H1 was accepted. Therefore, the test of the first hypothesis concluded: "there was a significant positive correlation between the mastery of the theory of aerodrome control procedures and the skills of air traffic control".

By applying linear regression, we can take multiple Y and predict the corresponding Y value in Fig 2. This is to minimize the vertical distance between all the data points and our line.

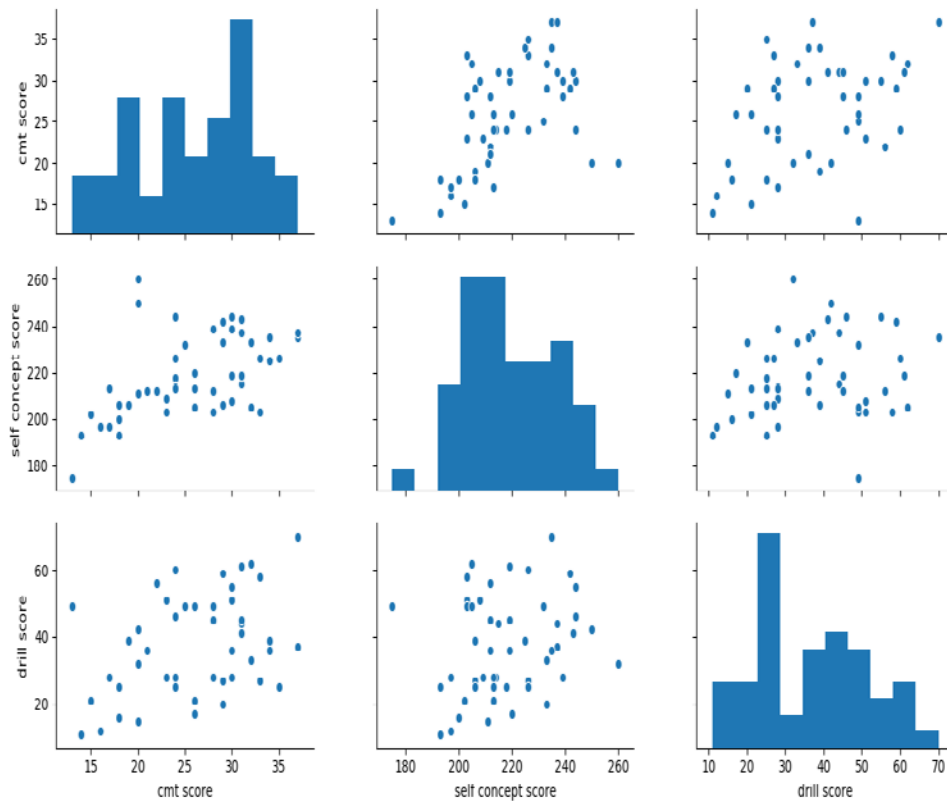


Figure 2. Distribution of Linear Regression

The result of the calculation of simple regression analysis on the third hypothesis proposed for the frequency of drill variable (X_3) and air traffic control skill variable (Y) was indicated by the regression line equation $\hat{Y} = 66.666 + 0.1412X_2$. The results indicated that an increase in one frequency of drill score caused an increase of 0.1412 score in air traffic control skill on the constant 66.666. In other words, if each frequency of drill score increased by 1, then the average score of air traffic control skill would increase by 0.1412.

The result of the correlation in figure 3 between frequency of drill and the skill of air traffic control was shown by the product moment correlation coefficient of $r_{y3} = 0.4159$ and the coefficient of significance test with t-test obtained by the value of $t\text{-count} = 3.1683$. The value of $t\text{-table}$ and $dk = 48$ and significance level is 0.05 was 2.01. The $t\text{-count} = 3.1683 > t\text{-table} = 2.01$ it can be said that the correlation between frequency of drill and skill of air traffic control was significant. This finding concluded that H_0 was rejected and H_1 accepted. Therefore, the test of the third hypothesis concluded that "there was a significant positive correlation between frequency of drill and the skill of air traffic control".

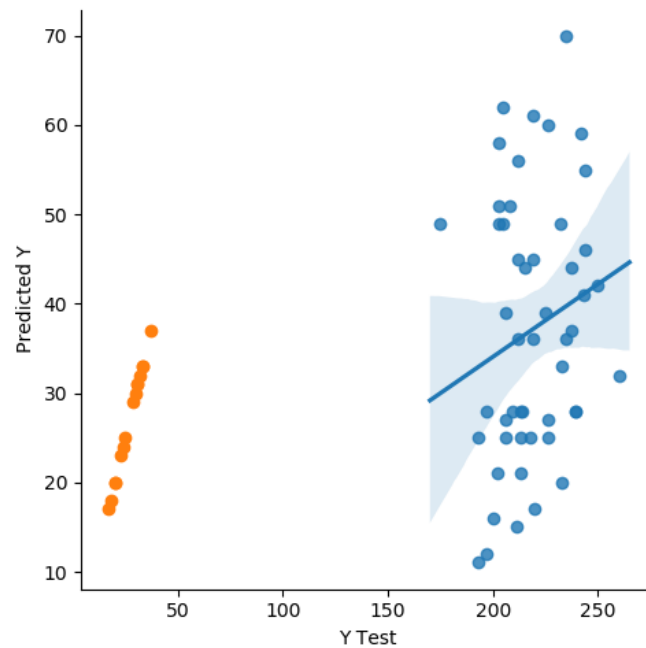


Figure 3. Correlation predicted Y

The coefficient index in this study can show in fig 4. For instance, if the regression coefficient of Y Test and Predictive Y, it would indicate that the Y Test will increase by 0.00 if predictive Y increase by 1 unit. A similar interpretation can be given for the regression coefficient of Y Test on predictive Y.

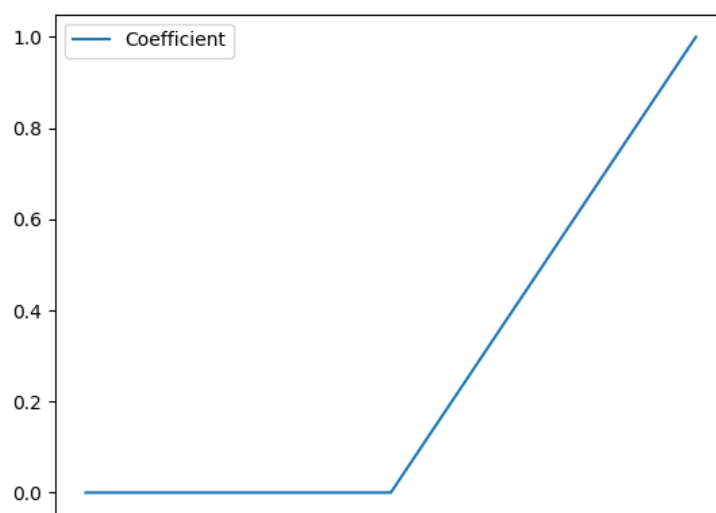


Figure 4. Coefficient Index

The coefficient of Y test in the line of regression of Y is called the regression coefficient of Y test on Predictive Y in fig.4. It represents a change in the value of the dependent variable (Y Test) corresponding to a unit change in the value of independent variable predictive Y.

The result of the correlation predictor variable is often correlated with each other in Table 1. The coefficient for drills is negative, implies that adding practice drills will reduce its value. This is because the predictor variable is correlated mastery theory tend to have more practice drills. Having correlated predictors can make it difficult to interpret the sign and value of the regression coefficient.

Table 1. Regression Coefficient

Score	Coefficient
drill	0.0000000000000000204
Self-concept	0.0
Control mastery theory	1

4. Conclusions

Based on the results obtained in the study, Determination coefficient of multiple correlations was 0.5478 or 54.78% showed that mastery theory of aerodrome control procedures, self-concept, and frequency of drills gave impact on skill of air traffic control.

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